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## 6. Residential Lighting

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### 6.1 Overview

This chapter is a one-stop place where a building department, builder, contractor, or lighting designer can get the information they need about residential lighting in low-rise buildings and in the dwelling units of high-rise buildings.

For residential buildings, all of the lighting requirements are mandatory measures. Therefore, lighting energy is not part of the energy budget for the whole building performance method, except as part of the standard assumption on internal heat gains that is assumed to be the same for all buildings. There are no tradeoffs between lighting and other building features.

#### 6.1.1 Scope

##### A. Low-Rise Residential Buildings

The residential lighting requirements apply to both indoor and outdoor lighting, in low-rise residential single-family buildings, and low-rise multi-family buildings.

The residential lighting requirements also apply to some spaces in buildings classified as nonresidential, as explained below in section 6.1.1 B of this chapter.

A low-rise residential building is defined in §100.1(b) of the Standards as a building, other than a hotel/motel, that is an Occupancy Group that is one of the following:

- R-2, multi-family, with three stories or less; or
- R-3, single family; or
- U-building, located on a residential site.

##### B. Residential Space Types in Nonresidential Building

The design and installation of all lighting systems, lighting controls and equipment in the following space types shall comply with the applicable provisions of the residential lighting requirements for newly constructed buildings and additions in §150.0(k), and the provisions of the residential lighting requirements for alterations in §150.2(b).

The residential lighting requirements apply to the following space types, as defined in §100.1(b) of the Standards:

1. Dwelling units in high-rise residential buildings
2. Outdoor lighting that is attached to a high-rise residential or hotel/motel building, and is separately controlled from the inside of a dwelling unit or guest room.
3. Fire station dwelling accommodations.
4. Hotel and motel guest rooms. Additionally, hotel and motel guest rooms shall meet the requirements of §130.1(c)8.

Following are the requirements for hotel and motel guest rooms in §130.1(c)8 of the Standards:

- Hotel motel guest rooms shall have captive card key controls, occupancy sensing controls, or automatic controls such that, no longer than 30 minutes after the guest room has been vacated, lighting power is switched off.

EXCEPTION: One high efficacy luminaire as defined in TABLE 150.0-A or 150.0-B that is switched separately and where the switch is located within 6 feet of the entry door.

5. Dormitory and senior housing dwelling accommodations.

### C. Nonresidential Buildings

The space types specifically listed in section B above are in buildings which are classified as nonresidential. All of the other space types in these nonresidential buildings are required to comply with the applicable nonresidential lighting Standards.

Typical nonresidential space types, required to comply with the applicable nonresidential lighting Standards include meeting rooms, corridors, public restrooms, stairs, support areas, exercise centers, hotel function areas, lobbies, lounge areas, offices, parking garages, and all other common areas.

Following are some relevant definitions from §100.1(b) of the Standards:

1. High-rise residential building is a building, other than a hotel/motel, of Occupancy Group R-2 or R-4 with four or more habitable stories.
2. Hotel/Motel is a building or buildings that has six or more guest rooms or a lobby serving six or more guest rooms, where the guest rooms are intended or designed to be used, or which are used, rented, or hired out to be occupied, or which are occupied for sleeping purposes by guests, and all conditioned spaces within the same building envelope.

Hotel/motel also includes all conditioned spaces which are

- a. On the same property as the hotel/motel,
  - b. Served by the same central heating, ventilation, and air-conditioning system as the hotel/motel, and
  - c. Integrally related to the functioning of the hotel/motel as such, including, but not limited to, exhibition facilities, meeting and conference facilities, food service facilities, lobbies, and laundries.
3. Nonresidential building is any building which is identified in the California Building Code Table; Description of Occupancy as Group A, B, E, F, H, M, or S; and is a U; as defined by Part 2 of Title 24 of the California Code of Regulation.

#### D. Existing Construction

“Additions” are treated the same as newly constructed buildings, so they must meet the applicable residential lighting requirements of §150.0(k).

In “alterations”, existing luminaires may stay in place, but all new luminaires that are permanently installed shall meet the applicable requirements of §150.0(k).

#### E. Permanently Installed Lighting

The residential lighting Standards apply only to permanently installed luminaires, i.e., luminaires that are attached to the house, as opposed to portable luminaires such as torchieres or table lamps.

Permanently installed luminaires include ceiling luminaires, chandeliers, vanity lamps, wall sconces, under-cabinet luminaires, and any other type of luminaire that is attached to the house. Permanently installed luminaires may include hard wired or plug-in luminaires.

- Permanently Installed lighting is defined as lighting that consists of luminaires that are affixed to land, within the meaning of Civil Code §658 and §660, except as provided below.
- Permanently installed luminaires may be mounted inside or outside of a building or site and may have either plug-in or hardwired connections for electric power.
- Permanently installed luminaires Examples of permanently installed lighting include track and flexible lighting systems; lighting attached to walls, ceilings, columns, inside or outside of permanently installed cabinets, internally illuminated cabinets, mounted on poles, in trees, or in the ground; attached to ceiling fans and integral to exhaust fans.
- Permanently installed lighting does not include portable lighting or lighting that is installed by the manufacturer in exhaust hoods for cooking equipment, refrigerated cases, food preparation equipment, and scientific and industrial equipment.
- Portable lighting is table and freestanding floor lamps with plug-in connections. Luminaires that are attached to the bottom of a kitchen cabinet are classified as permanent, even when they have plug-in connections.

See section 6.3.1 of this chapter for additional information about permanently installed luminaires.

#### F. Outdoor Lighting

Some residential outdoor lighting is subject to the residential lighting requirements, and some residential outdoor lighting is subject to the nonresidential requirements, as described in section 6.7 of this chapter.

For single-family residences, all lighting attached to the residence or to other buildings on the same lot must be high efficacy, or controlled by a motion sensor **and** either a photocell or an astronomical time clock. The same requirements apply to the outdoor lighting of low-rise multifamily buildings with certain exceptions, and to the outdoor lighting on private patios of high-rise multifamily when the lighting is controlled from inside each individual dwelling unit.

Outdoor residential lighting is sometimes subject to the residential lighting requirements, and sometimes subject to the nonresidential lighting requirements. To help clarify the distinction, Figure 6-10 shows which requirements apply to various types of outdoor lighting for each building type.

**G. Figure 6.7 Signs**

Internally illuminated address signs shall consume no more than 5 watts of power (watts shall be determined according to §130.0(c)), or shall comply with the applicable nonresidential sign lighting requirements in §140.8 of the Standards

See section 6.7.4 of this chapter for additional information about signs on residential buildings.

**6.1.2 Summary of Requirements by Space Type**

For each room or area, the lighting requirements may be summarized as follows:

**A. Kitchens**

At least half the installed wattage of luminaires in kitchens shall be high efficacy. However, lighting installed inside cabinets may not be required to be included in the wattage calculation that determines whether half of the installed wattage is high efficacy. See section 6.6 of this chapter for information about residential kitchen lighting requirements.

**B. Bathrooms**

At least one luminaire in each bathroom must be high efficacy. All other luminaires in a bathroom must be either high efficacy, or controlled by vacancy sensors. See section 6.6.2 of this chapter for information about residential lighting requirements in bathrooms.

**C. Garages, Laundry Rooms, and Utility Rooms**

All luminaires must be high efficacy, and must be controlled by a vacancy sensor. See section 6.6.3 of this chapter for information about residential lighting requirements in these rooms.

**D. Other Rooms**

This classification applies only to rooms that are not kitchens, bathrooms, garages, laundry rooms, closets, or utility rooms. All installed luminaires shall either be high efficacy or shall be controlled by a vacancy sensor or dimmer. Closets that are less than 70 ft<sup>2</sup> are exempt from this requirement. See section 6.6.4 of this chapter for information about residential lighting requirements in these rooms.

**E. Outdoor Lighting – Single Family**

In single-family residences, all luminaires mounted to the building (or to other buildings on the same lot) shall be high efficacy luminaires, or shall be controlled by a motion sensor and also by a photocontrol, astronomical time clock, or energy management control system (EMCS). See section 6.7.1 of this chapter for information about residential outdoor lighting requirements for single-family residences.

**F. Outdoor Lighting – Multifamily**

Outdoor lighting for multifamily buildings is sometimes subject to the nonresidential outdoor lighting requirements. See sections 6.7.2 and 6.7.3 of this chapter for information about residential outdoor lighting requirements for multi-family buildings.

## **G. Interior Common Areas of Multifamily Buildings**

For high-rise multifamily buildings, the lighting of common areas shall comply with the nonresidential lighting requirements.

For low-rise multifamily buildings, if the total interior common area of the building equals 20% or less of the floor area, common area lighting shall be high efficacy or controlled by an occupant sensor. If the total interior common area of the building equals more than 20% of the floor area, common area lighting shall meet the nonresidential lighting requirements. See section 6.8 of this chapter for information about residential lighting requirements for interior common areas of multifamily buildings.

## **H. Parking Lots**

The nonresidential outdoor lighting Standards apply to residential parking lots or garages with space for eight or more cars, which are typically for multifamily buildings. The Nonresidential Lighting Standards for parking lots and/or garages apply in these cases (§130.2, §140.7). See section 6.7.7 for additional information about lighting Standards for residential parking lots or residential garages with space for eight or more cars. See section 6.7.7 of this chapter for information about lighting in residential parking lots.

### **6.1.3 Residential Luminaire Requirements**

Residential luminaires are classified as being either “high efficacy” or “low efficacy” for the purpose of compliance, according to the requirements described in Section 6.3.2 and 6.3.3.

The residential lighting Standards have requirements for electronic ballasts (section 6.3.8), permanently installed night lights (section 6.3.9), lighting integral to exhaust fans (section 6.3.11), and lighting switching requirements (sections 6.5 and 6.6 of this chapter).

Luminaires that are recessed into ceilings shall have airtight housings to prevent conditioned air escaping into the ceiling cavity or attic, or unconditioned air infiltrating from the ceiling or attic into the conditioned space.

Luminaires that are recessed into insulated ceilings are required to be rated for insulation contact (“IC-rated”) so that insulation can be placed over them. See sections 6.3.9; 6.3.12; and 6.3.13 of this chapter for additional information about luminaires recessed into insulated ceilings.

### **6.1.4 Related Documents**

There are a number of publications and documents available from the California Energy Commission and others that provide additional information about residential lighting. A summary of these is listed below:

- A. The Nonresidential Compliance Manual should be consulted for more details on the requirements for parking lots and parking garages.

The Residential Lighting Design Guide, (Best practices and lighting designs to help buildings comply with California’s Title 24 energy code) is available from the California Lighting Technology Center ([www.CLTC.ucdavis.edu](http://www.CLTC.ucdavis.edu)).

- B. The Advanced Lighting Guidelines, available from the New Buildings Institute ([www.newbuildings.org](http://www.newbuildings.org)) is an informative resource for energy efficient lighting design, luminaires, and controls. While the document is mostly oriented for nonresidential

lighting applications, it has generic information about lamps, ballasts, luminaires, and controls that is applicable to low-rise residential buildings.

- C. Professionally qualified lighting designers can be quickly located via the websites of the International Association of Lighting Designers ([www.iald.org/index](http://www.iald.org/index)), or the National Council on Qualifications for the Lighting Professions (NCQLP): [www.ncqlp.org](http://www.ncqlp.org)). Many designers are ready to offer informal advice as well as undertake commissioned work.
- D. Many books on residential lighting design are available. The best books explain the principles of good lighting design as well as showing examples of luminaires. The fast pace of lamp development makes recently written books much more useful.
- E. Guidance on the selection and use of lighting technologies is available from the Lighting Research Center's National Lighting Product Information Program, at [www.lrc.rpi.edu/programs/nlpip](http://www.lrc.rpi.edu/programs/nlpip). Additional resources for energy efficient lighting and other building systems are available from the California Building Industry Institute at [www.thebii.org](http://www.thebii.org).

## 6.2 Certification to the Energy Commission

§100(k); §110; §119

Certification to the Energy Commission is completed by manufacturers of regulated devices. Certification includes a declaration of compliance, executed under penalty of perjury of the laws of California, that the regulated device meets the requirements of the Standards.

- A. For compliance with the Title 20 Appliance Efficiency Regulations and the Title 24 Building Energy Efficiency Standards, the Energy Commission maintains a database of appliances, controls, and other devices which have been certified to the Energy Commission.
- B. For compliance with the residential lighting Standards, this database includes lighting controls, ballasts for residential recessed luminaires, and high efficacy LED lighting systems.
- C. Lighting controls, and ballasts for residential recessed luminaires are two of the devices which shall not be installed unless they have been certified by the manufacturer and listed on this database.
- D. LED lighting systems cannot be counted as “high efficacy” for the purposes of code compliance unless that have been certified and listed on the database. The database and certification instructions are available from the following web links:  
[www.energy.ca.gov/appliances/database/index.html](http://www.energy.ca.gov/appliances/database/index.html)  
[www.energy.ca.gov/appliances/forms/](http://www.energy.ca.gov/appliances/forms/)
- E. Building departments, builders, contractors, and lighting designers should check to database to verify that a regulated device has been certified to the Energy Commission by the manufacturer of that device.

### 6.2.1 Self-Contained Lighting Controls

Self-contained lighting controls are required to be certified to the Energy Commission by the manufacturer.

- A. A self-contained lighting control is defined as a unitary lighting control module that requires no additional components to be a fully functional lighting control.
- B. Self-contained lighting control devices cannot be sold or offered for sale in California unless they have been certified to the Energy Commission according to the Title 20 Appliance Efficiency Regulations.



Figure 6-1 – Self-Contained Lighting Controls

## 6.2.2 Lighting Control Systems

- A. A lighting control system is defined by the Standards as requiring two or more components to be installed in the building to provide all of the functionality required to make up a fully functional and compliant lighting control. Therefore, a lighting control system must functionally meet all applicable requirements in the Standards.
- B. Lighting control systems are not required to be certified to the Energy Commission, but are required to comply with the minimum performance requirements in §110.9, and a Certificate of Installation must be signed in accordance with the requirements in §130.4.
  - 1. The minimum performance requirements in §110.9 of the Standards requires that a lighting control system functionally meet all of the requirements that a self-contained lighting control is required to meet. For example, a vacancy sensor system must functionally meet all of the requirements in the Title 20 Appliance Efficiency Regulations for a self-contained vacancy sensor.
  - 2. A single lighting control system that is installed to provide the functionality of more than one lighting control device is required to provide all of the functionality of each respective lighting control for which it is installed.
  - 3. Whenever a lighting control system is installed to comply with lighting control requirements in Title 24, a licensee of record must fill out and sign an Certificate of Installation in accordance with the requirements in §130.4. If the Certificate of Installation is not submitted, the lighting control system shall not be recognized for compliance with the Standards.
- C. Specific types of lighting control systems must also meet the following requirements:
  - 1. An Energy Management Control System (EMCS) may be used to comply with dimmer requirements if at a minimum it provides the functionality of a dimmer, and a Certificate of Installation is signed.
  - 2. An Energy Management Control System (EMCS) may be used to comply with vacancy sensor requirements if at a minimum it provides the functionality of a vacancy sensor, and a Certificate of Installation is signed.
  - 3. A multi-scene programmable controller may be used to comply with dimmer requirements if at a minimum it provides the functionality of a dimmer.
  - 4. Lighting controls and equipment are required to be installed in accordance with the manufacturer's instructions.

### 6.2.3 Qualifying LED as High Efficacy

For a light emitting diode (LED) lighting system to qualify as high efficacy for compliance with the residential lighting Standards, an LED luminaire, or LED light engine shall be certified to the Energy Commission by the manufacturer as meeting all of the following conditions:

1. Shall meet the minimum efficacy requirements in Table 150.0-B (explained in sections 6.3.2 and 6.3.3 of this chapter). The LED lighting system shall be tested by an independent testing lab, according to IES LM-79-08.

For calculating kitchen lighting loads, input power shall be determined as specified by §130.0(c)9 (explained in section 6.4 of this chapter).

See section 6.3.7; 6.4.6; and 6.9 of this chapter for additional information about residential LED lighting requirements.

### 6.2.4 Ballasts for Compact Fluorescent Luminaires

All ballasts for compact fluorescent luminaires, when used in residential recessed luminaires, shall be certified by the manufacturer to the Energy Commission according to §110.9(f), as meeting the following conditions:

1. Be rated by the ballast manufacturer to have a minimum rated life of 30,000 hours when operated at or below a specified maximum case temperature. This maximum ballast case temperature specified by the ballast manufacturer shall not be exceeded when tested in accordance to UL 1598 §19.15; and
2. Have a ballast factor of not less than 0.90 for non-dimming ballasts and a ballast factor of not less than 0.85 for dimming ballasts.

## 6.3 Requirements for Residential Luminaires

A luminaire is the lighting industry's term for light fixture. A luminaire consists of the housing, power supply (for instance a ballast, transformer, or driver), lamp, and optical components such as reflectors or lenses. A lamp is the lighting industry's term for a light bulb.

Although portable table and floor lamps are classified as luminaires, they are not covered by the Title 24 residential lighting Standards. However, portable luminaires are required to comply with the California Title 20 Appliance Efficiency Regulations.

Every installed luminaire shall be classified as either "high efficacy" or "low efficacy" for compliance with the residential lighting Standards. There are different requirements for high and low-efficacy luminaires. The rules for classifying a luminaire as high efficacy are explained further in sections 6.3.2 and 6.3.3 of this chapter.

### 6.3.1 Permanently Installed vs. Portable Luminaires

The residential lighting Standards require that all permanently installed luminaires be high efficacy as defined in §150.0(k)1, with some exceptions described in section 6.6 of this chapter. The residential lighting Standards do not apply to portable luminaires.

- A. Permanently installed luminaires include all luminaires attached to the inside or outside of a building or other structures on the same site. Permanently installed luminaires may have either plug-in or hardwired connections for electric power. This includes plug-in under-cabinet lighting where the luminaires are attached to the bottom of the cabinets.
- B. The definition of permanently installed lighting in §100.1 includes outdoor lighting mounted on poles, in trees, or in the ground. However, because outdoor lighting mounted on poles, in trees, or in the ground is not regulated by the residential lighting Standards, this portion of the definition applies only to nonresidential outdoor lighting applications.
  1. Permanently installed lighting includes the following:
    - a. Lighting attached to walls, ceilings, columns.
    - b. Track and flexible lighting systems.
    - c. Lighting inside permanently installed cabinets.
    - d. Lighting attached to the top or bottom of permanently installed cabinets.
    - e. Lighting attached to ceiling fans.
    - f. Lighting integral to exhaust fans.
    - g. Lighting that is integral to garage door openers if it is designed to be used as general lighting, is switched independently from the garage door opener, and does not automatically turn off after a pre-determined amount of time.

2. Permanently installed lighting does not include the following:
  - a. Portable lighting as defined by §100.1 (table and freestanding floor lamps with plug-in connections).
  - b. Lighting installed by the manufacturer in refrigerators, stoves, microwave ovens, exhaust hoods for cooking equipment, refrigerated cases, vending machines, food preparation equipment, and scientific and industrial equipment.
  - c. Lighting in garage door openers which consists of no more than two screw-based sockets integrated into the garage door opener by the manufacturer, where the lights automatically turn on when the garage door is activated, and automatically turn off after a pre-determined amount of time.
- C. Portable lighting, for residential applications, is defined as lighting with plug-in connections for electric power that is table and freestanding floor lamps. However, plug-in lighting attached to the bottom of a cabinet is considered permanently installed lighting.

### 6.3.2 Residential High Efficacy Luminaires

§150.0(k)1

A high efficacy luminaire is one that meets the criteria listed in Table 6-1, or if the lighting technology is not covered in Table 6-1, qualifies as high efficacy in accordance with Table 6-2.

To determine whether a luminaire is classified as high efficacy or low efficacy, first refer to **Table 6-1**. If the luminaire is not listed in either of the two columns in Table 6-1, then use Table 6-2, to determine whether it qualifies as high efficacy.

When required to calculate efficacy according to Table 6-2, simply divide the initial rated lumens of the lamp by the rated wattage of the lamp. Lamp lumens can typically be found on the lamp package or in a manufacturer's catalogue

### 6.3.3 Residential Low Efficacy Luminaires

§150.0(k)2

- A. A low efficacy luminaire is one that meets the criteria listed in Table 6-1. If a luminaire consists of a lighting technology that is not specifically covered by Table 6-1, it shall be classified as low efficacy if it does not meet the minimum efficacy requirements in Table 6-2.
- B. Typical examples of low efficacy luminaires include:
  1. LED lighting which has not been certified to the Energy Commission as high efficacy.
  2. Line-voltage socket or lamp holders, except for GU-24. These include conventional medium screw-base sockets, candelabra sockets, pin-based sockets, or any other type of line-voltage lamp holders capable of accepting any type of incandescent lamp, or any other type of low efficacy lamp.
  3. Low voltage incandescent lighting.
  4. Track lighting of any type, or any other lighting systems which allows the addition or relocation of luminaires without altering the wiring of the system.

- 
5. Lighting systems which have modular components that allow conversion between screw-based and pin-based sockets without changing the luminaires' housing or wiring.
    - C. Unfinished electrical boxes are also classified as low efficacy luminaires. This applies to electrical boxes that are finished with a blank cover or electrical boxes where no electrical equipment has been installed, where the electrical box can be used for a luminaire or a surface mounted ceiling fan.
    - D. LED luminaires that have not been certified to the Energy Commission in accordance with the requirements in Reference Appendix JA-8, are classified as low efficacy, even if they meet the efficacy requirements of Table 6-2.
    - E. See section 6.9 of this chapter for additional information about qualifying LED as high efficacy lighting.
    - F. Any luminaire that contains a socket that can be fitted with an incandescent lamp is classified as low efficacy, even if a compact fluorescent or LED lamp is installed into that socket.
    - G. The Standards do not recognize any socket adaptors as permanent, even when classified as permanent by the manufacturer.

Table 6-1- (Table 150.0-A in the Standards) Efficacy Classification of Common Light Sources

<p align="center"><b>High Efficacy Light Sources</b></p> <p>Luminaires manufactured, designed and rated for use with only lighting technologies in this column shall be classified as high efficacy:</p>	<p align="center"><b>Low Efficacy Light Sources</b></p> <p>Luminaires manufactured, designed or rated for use with any of the lighting technologies in this column shall be classified as low efficacy.</p>
<ul style="list-style-type: none"> <li>• Pin-based linear fluorescent lamps or pin-based compact fluorescent lamps, provided that the ballast in the luminaire is electronic. Compact fluorescent lamps ≥ 13 watts have 4 pins for compliance with the electronic ballast requirements in §150.0(k)1D.</li> <li>• Pulse-start metal halide lamps.</li> <li>• High pressure sodium lamps.</li> <li>• GU-24 sockets rated for LED lamps.</li> <li>• GU-24 sockets rated for compact fluorescent lamps.</li> <li>• Luminaires using LED light sources which have been certified to the Commission as high efficacy in accordance with Reference Joint Appendix JA8.</li> <li>• Luminaire housings rated by the manufacturer for use with only LED light engines.</li> <li>• Induction lamps.</li> </ul> <p>Note: Adaptors which convert an incandescent lamp holder to a high-efficacy lamp holder shall not be used to classify a luminaire as high efficacy, even if the manufacturer declares that such adaptors as permanent.</p>	<ul style="list-style-type: none"> <li>• Line-voltage lamp holders (sockets) capable of operating incandescent lamps of any type.</li> <li>• Low-voltage lamp holders capable of operating incandescent lamps of any type.</li> <li>• High efficacy lamps installed in low-efficacy luminaires, including screw base compact fluorescent and screw base LED lamps.</li> <li>• Mercury vapor lamps.</li> <li>• Track lighting or other flexible lighting system which allows the addition or relocation of luminaires without altering the wiring of the system.</li> <li>• Luminaires using LED light sources which have not been certified to the Commission as high efficacy.</li> <li>• Lighting systems which have modular components that allow conversion between high-efficacy and low-efficacy lighting without changing the luminaires' housing or wiring.</li> <li>• Electrical boxes finished with a blank cover or where no electrical equipment has been installed, and where the electrical box can be used for a luminaire or a surface mounted ceiling fan.</li> </ul>

Table 6-2 – (Table 150.0-B in the Standards) Efficacy Classification of Uncommon Light Sources

<p>Use this table to determine luminaire efficacy and classification only for lighting systems not listed in TABLE 150.0-A</p>	
<p align="center"><b>Luminaire Power Rating</b></p>	<p align="center"><b>Minimum Luminaire Efficacy to Qualify as High Efficacy</b></p>
<p align="center">5 watts or less</p>	<p align="center">30 lumens per watt</p>
<p align="center">over 5 watts to 15 watts</p>	<p align="center">45 lumens per watt</p>
<p align="center">over 15 watts to 40 watts</p>	<p align="center">60 lumens per watt</p>
<p align="center">over 40 watts</p>	<p align="center">90 lumens per watt</p>
<p>Note: Determine minimum luminaire efficacy using the system initial rated lumens divided by the luminaire total rated system input power.</p>	

### 6.3.4 Residential Hybrid LED Luminaires

Some luminaires contain both LEDs and other light sources. These are known as hybrid LED luminaires. When the LED source has been certified to the Energy Commission as high efficacy, and the other light source in the hybrid luminaire also qualifies as high

efficacy according to Table 6-1 or Table 6-2 of this chapter, the entire luminaire may be classified as high efficacy for compliance with the residential lighting Standards.

However, when a certified high efficacy LED source system is combined with a low efficacy lighting system in a Hybrid LED Luminaire, the high efficacy and low efficacy lighting systems shall each separately comply with the applicable requirements of §150.0(k). This means that the specific requirements of each residential room type apply to the high efficacy and low efficacy parts of the luminaire respectively.

### 6.3.5 GU-24 Luminaires

Luminaires with GU-24 sockets which are rated for use with only LED lamps, fluorescent lamps, or high intensity discharge lamps, are automatically classified as high efficacy for residential use, and are a cost-effective way of installing high efficacy lighting.

Luminaires with GU-24 sockets sold or offered for sale in California shall accept only high efficacy lamps, and GU-24 lamps shall only be high efficacy, according to the Title 20 Appliance Efficiency Regulations. The shape and size of the GU-24 socket enables it to be manufactured into any luminaire that could use an Edison Screw socket. This means that many residential luminaire manufacturers offer GU-24 sockets as an option in all their screw-based luminaires, making it possible for all these luminaires to be classified as high-efficacy without incurring additional cost.

Compact fluorescent lamps and LED lamps are available with GU-24 bases, as shown in Figure 6-36-3. Note that the Edison-base-to-GU-24 socket adaptor shown on the right side of Figure 6-3 shall never be recognized for compliance with the residential lighting Standards. However, California law does not prohibit the installation of such adaptors in previously installed luminaires, provided that such luminaires are not used to comply with Title 24.

Under the California Title 20 Appliance Efficiency Regulations, it is illegal to sell or offer for sale an incandescent lamp with a GU-24 base, a luminaire with a GU-24 socket that is rated for incandescent lamps, or an adaptor that converts a GU-24 socket to an Edison socket.

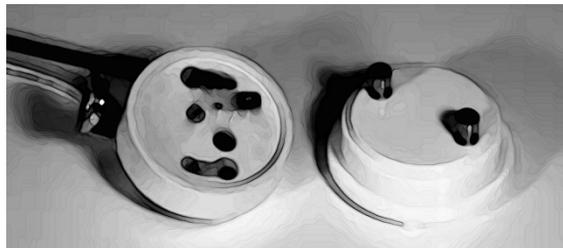


Figure 6-2 – GU-24 socket and base



Source: [http://www.northernlightsusa.com/sites/default/files/imagecache/product\\_full/GU24\\_0.jpg](http://www.northernlightsusa.com/sites/default/files/imagecache/product_full/GU24_0.jpg).

Figure 6-3 – GU-24 Lamps

### 6.3.6 No “Permanent” GU-24 Adaptors

Luminaires manufactured and rated with only GU-24 sockets are recognized as high efficacy. The Standards do not recognize any socket adaptor as being able to permanently convert one type of luminaire to another type of luminaire for compliance with the Standards. For example, there are no “permanent” adaptors recognized for converting a luminaire with an incandescent screw-base socket to a permanently installed compact fluorescent luminaire, regardless of manufacturer declarations.



Figure 6-4 – A screw-base to GU-24 socket adaptor is not recognized as high efficacy by Title 24.

### 6.3.7 LED Must Be Certified to Qualify as Residential High Efficacy

Unlike CFL and GU-24 luminaires, LED luminaires must be certified to the Commission by the manufacturer to qualify as “high efficacy”. If LEDs are not certified, they are classified as low efficacy regardless of their actual efficacy.

Screw-based compact fluorescent lamps have never been recognized as permanently installed fluorescent lighting systems for compliance with the Standards. Similarly, LED screw based lamps, and LED screw based light engines, are also not recognized as an LED luminaire for compliance with the Standards.

There are special provisions for LED lamps that have GU-24 bases—these qualify automatically as an LED luminaire. See section 6.3.5 of this chapter for additional information about luminaires with GU-24 sockets.

The market for LED luminaires has given rise to new types of luminaires and new terminology within the lighting industry. This new terminology can be confusing;

Table 6-3

sets out the five types of LED lighting, and shows how to determine whether each type is high efficacy or low efficacy.

Table 6-3 – Classification of LED Luminaire Types

LED Type	Common examples	Is this a high efficacy luminaire?	Method for calculating Installed Kitchen lighting power
A. Integral LED luminaire	Most LED under cabinet luminaires Most LED picture lights	Yes, if it has been certified to the Energy Commission	Treat as LED luminaire (§130.0(c)9)
B. Luminaire with replaceable LED light engine	Recessed LED luminaires that have a replaceable proprietary light engine	Yes, if it does not contain a screw base or other ANSI base, and the light engine has been certified to the Energy Commission	Treat as LED luminaire (§130.0(c)9)
C. Integrated LED lamp with GU-24 base	GU-24 LED lamps LED trims designed to fit into recessed cans not having incandescent sockets.	Yes, if the luminaire has a GU-24 socket and is rated for use with only LEDs.	Treat as LED luminaire (§130.0(c)9)
D. Integrated LED lamps with any type of incandescent base	Screw-based LED lamps or LED trims designed to fit into incandescent recessed cans.	Never qualify as high efficacy	Treat as a line-voltage luminaire or line-voltage track as applicable (§130.0(c)2 or 7)
E. Non-integrated LED lamp	MR16 or MR11 lamps with “bi-pin” (GU5.3 or GX5.3) sockets that are powered by a 12V transformer	Never qualify as high efficacy	Treat as low voltage lighting (§130.0(c)8)
F. Luminaire housings rated by the manufacturer for use with only LED light engines.	Recessed down lights, surface or wall mounted residential lights, outdoor luminaires and flood lights.	Only if, at the time the Certificate of Installation is completed, it has been fitted with a LED light engine which has been certified as high efficacy to the Energy Commission	Treat as LED luminaire (§130.0(c)9)

The six types of LED lighting in Table 6-3 are defined as follows:

#### A. Integral LED luminaire.

These are luminaires in which the LEDs cannot be removed from the luminaire. The luminaire forms a single unitary device in which the lamps are not replaceable. Many picture lights and under cabinet lights are integral LED luminaires. Integral LED luminaires are high efficacy if they are certified by the manufacturer to the Commission (as described in Reference Joint Appendix JA8). LED luminaires not certified to the Energy Commission are classified as low efficacy, regardless of their actual efficacy.

#### B. Luminaire with replaceable LED light engine

These are similar to integrated LED lamps (above), except that the socket is not an ANSI standard socket, and is designed to connect to a luminaire housing rated for LED light engines. The connection may include a quick connect, GU-24, or other type of non-incandescent lamp holder. Many recessed LEDs are built this way. Integral LED luminaires are high efficacy only if they are certified by the manufacturer to the Energy Commission (as described in Reference Joint Appendix JA8. See section 6.9 of this chapter).

#### C. Integrated LED lamp with GU-24 base

These are LED lamps which contain their own drivers, and can be directly connected to a GU-24 line-voltage socket through an ANSI GU-24 standard base.

#### D. Integrated LED Lamps with Any Type of Incandescent Base

These are lamps which contain their own drivers, and can be directly connected to a line-voltage socket through any type of incandescent base. Integrated LED lamps that fit into any type of incandescent luminaire never qualify as high efficacy luminaires for compliance with the Standards because they can be replaced with incandescent lamps.

#### **E. Non-integrated LED lamp**

These are similar to an integrated LED lamp with an incandescent base except that the replaceable part (the lamp) does not contain its own driver (the driver is located within the luminaire). Non-integrated lamps must have ANSI sockets. Most low-voltage LED track spotlights are non-integrated lamps. These lamps never qualify as high efficacy luminaires because they could easily be replaced with incandescent lamps.

#### **F. Luminaire housings rated by the manufacturer for use with only LED light engines**

These are luminaire housings into which LED light engines can be installed. An LED light engine is defined in ANSI/IES RP-16-10 as an integrated assembly comprised of LED packages (components) or LED arrays (modules), LED driver, and other optical, thermal, mechanical, and electrical components. The device is intended to connect directly to the branch circuit through a custom connector compatible with the LED luminaire for which it was designed and does not use an ANSI standard base.

It is expected that an LED light engine, which has been certified by the manufacturer to the Energy Commission as high efficacy, has been installed prior to completion of the Certificate of Installation by the licensee of record (see section 6.10 of this chapter).

### **6.3.8 Electronic Ballasts**

§150.0(k)1D

Fluorescent lamps with a power rating of 13 watts or more shall have electronic ballasts that operate the lamp at a frequency of 20 kHz or more. Most commonly available electronic ballasts meet this requirement.

If in doubt, look at the number of pins protruding from the compact fluorescent lamp base. Pin-based compact fluorescent lamps operated with electronic ballasts typically have four-pin lamp holders. Pin-based compact fluorescent lamps with two-pin lamp holders typically indicate that the ballast is magnetic. Be careful not to confuse pin-based CFL sockets with GU-24 sockets.

There are additional requirements for compact fluorescent ballasts, when in recessed luminaires, to be certified to the Energy Commission. See section 6.3.9 of this chapter for additional information.

High intensity discharge (HID) lamps (like pulse-start metal halide or high-pressure sodium) are not required to have electronic ballasts. This requirement does not apply to HID luminaires.

### **6.3.9 Ballasts for Residential Recessed Luminaires**

§110.9(f)

For recessed luminaires with compact fluorescent ballasts, the ballasts shall be certified to the Energy Commission. For additional information on certifying ballasts and other devices to the Energy Commission, see section 6.2 of this chapter. The luminaire shall be designed and installed to allow ballast maintenance and replacement to be readily accessible to building occupants from below the ceiling without requiring the cutting of holes in the ceiling.

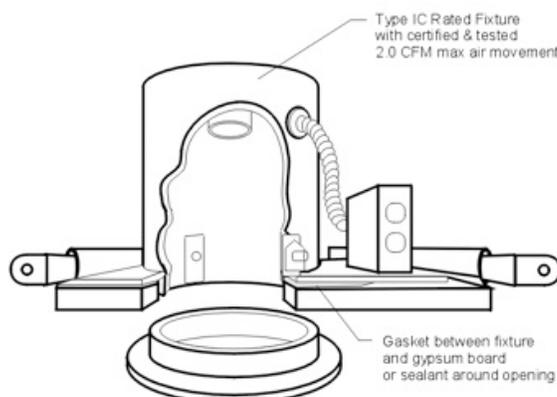


Figure 6-5 –Airtight, Type IC Luminaire

### 6.3.10 Night Lights

§150.0(k)1E

Permanently installed night lights and night lights integral to an installed luminaire or exhaust fan shall be rated to consume no more than 5W of power per luminaire or exhaust fan, as determined by §130.0(c). Night lights are not required to be controlled by vacancy sensors, regardless of the type of room they are located in.

*Note:* Indicator lights that are integral to lighting controls shall not consume more than 5W of power per switch in accordance with §110.9(a)5.

### 6.3.11 Lighting Integral to Exhaust Fans

§150.0(k)1F

Lighting integral to exhaust fans shall meet the applicable requirements of §150.0(k). However, lighting which is part of a kitchen stove exhaust hood is not required to comply with §150.0(k). This lighting integral to exhaust fans shall be controlled separately from the exhaust fan according to §150.0(k)2B. See sections 6.5.2 for more information about lighting attached to or integral to exhaust fans.

### 6.3.12 IC/AT Luminaires Recessed in Ceilings

§150.0(k)8

Luminaires recessed in ceilings must meet special requirements due to the potential for thermal bridging and air paths through the ceiling insulation, and to the potential for heat build-up in the fixture to compromise the performance of the lamp. Air leaks degrade insulation performance, and can also permit condensation on the cold surface of the luminaire if exposed to moist air; for instance, in a bathroom.

Under the 2013 code, these requirements apply to all recessed luminaires (under the 2008 code they applied only to luminaires in insulated ceilings).

Luminaires recessed in ceilings must meet three requirements:

- A. They shall be listed, as defined in §100.1, for zero clearance insulation contact (IC) by Underwriters Laboratories or other nationally recognized testing/rating laboratories. This enables insulation to be packed in direct contact with the luminaire.
- B. They shall have a label certifying that the luminaire has airtight construction. Airtight construction means that leakage through the luminaire will not exceed 2.0 CFM when exposed to a 75 Pascals pressure difference, when tested in accordance with ASTM E283 (An exhaust fan housing shall not be required to be certified airtight).
- C. They shall be sealed with a gasket or caulking between the luminaire housing and ceiling, and shall have all air leak paths between conditioned and unconditioned spaces sealed with a gasket or caulk, to prevent the flow of heated or cooled air out of the living areas and into the ceiling cavity.

The residential lighting Standards allow the use of either a gasket or caulking, and do not favor one of these methods over the other. See section 6.3.13 of this chapter for helpful information on what to look for to make sure that all air leak paths have been sealed.

The following performance requirements also apply:

- A. They be certified to the Commission to comply with the applicable ballast requirements in §110.9(f) (150.0(k)8D)
- B. They shall allow ballast maintenance and replacement to be readily accessible to building occupants from below the ceiling without requiring the cutting of holes in the ceiling (150.0(k)8E)
- C. Ballasts for fluorescent lamps rated 13 watts or greater shall be electronic and shall have an output frequency no less than 20 kHz.150.0(k)1D

#### Example 6-1: Recessed luminaires: fire-rated housings

##### Question

If a factory manufactured fire rated luminaire housing is placed over a recessed luminaire in a multi-family residential dwelling unit, is the luminaire still required to comply with the IC requirements?

##### Answer

There are limited applications where a non-IC luminaire may be used conjunction with a manufactured fire rated luminaire housing in a multi-family residential dwelling unit. However, the luminaire shall still comply with all of the airtight requirements.

A non-IC luminaire may be used in a ceiling in conjunction with a fire rated housing only if all three of the following conditions are met:

1. The multi-family dwelling unit is an occupancy type R1 or R2; and
2. The luminaire is recessed between different dwelling units that are regulated by California Building Code §712.4.1.2; and
3. The manufactured fire rated housing is rated for a minimum of 1 hour fire in accordance with UL 263.

### 6.3.13 Building Official Inspection of IC/AT Requirements

§150.0(k)12

- A. As covered in section 6.3.12 of this chapter, recessed luminaires shall be IC rated and have a gasket or caulking between the housing and ceiling to prevent the flow of heated or cooled air between conditioned and unconditioned spaces.
- B. The luminaire shall include a label certifying airtight or similar designation to show air leakage less than 2.0 CFM at 75 Pascals when tested in accordance with ASTM E283. The label shall be clearly visible for the building inspector. The building inspector may verify the IC and ASTM E283 labels at a rough inspection. If verified at final inspection the building inspector may have to remove the trim kit to see the labels.
- C. The ASTM E283 certification is a laboratory procedure intended to measure only leakage of the luminaire housing or, if applicable, of an airtight trim kit, and not the installation.

Luminaire housings labeled as airtight, airtight ready or other airtight designation does not establish that a luminaire has been installed airtight.

The luminaire manufacturer shall provide instructions that explain the entire assembly required to achieve an airtight installation.

- D. There are several different methods used by manufacturers to meet the airtight standards. The residential lighting Standards do not favor one airtight method over another, including they do not prefer the use of gaskets over caulk, or the use of caulk over gaskets for compliance with the Standards.

Because a luminaire housing is not always installed perfectly parallel to the ceiling surface, both methods have their benefits as follows:

1. Caulk will generally fill in and seal wide and uneven gaps. However, after the caulk dries, it may permanently attach the luminaire housing or trim to the ceiling surface. Therefore, the caulk may need to be cut away from the ceiling surface in the event that a luminaire housing or trim needs to be moved away from the ceiling.
2. Many gaskets allow the luminaire housing or trim to be readily moved away from the ceiling surface after it has been installed. However, if the gasket is too thin, or not made out of an air stopping type of material, it may not sufficiently reduce the air flow between the conditioned and unconditioned spaces.

Although the Standards do not specify the type of material needed for a gasket, it is likely that an open cell type of foam, particularly if the gasket is relatively thin, will not create an airtight barrier.

- E. The primary intent is to install a certified airtight luminaire so that it is sufficiently airtight to prevent the flow of heated or cooled air between conditioned and unconditioned spaces. All air leak paths through the luminaire assembly or through the ceiling opening shall be sealed. Leak paths in the installation assembly that are not part of the ASTM E283 testing shall be sealed with either a gasket or caulk.

One example may apply for assemblies where a certified airtight luminaire housing is installed in an adjustable mounting frame; all air leak paths between the certified airtight luminaire housing and the adjustable mounting frame shall be sealed, either with a gasket or caulk.

Following is the process for verifying that the requirements for an airtight installation are met.

1. Manufacturer specifications (a "cut sheet") of the certified airtight luminaire housing(s) and installation instructions shall be made available with the plans to show all components of the assembly that will be necessary to insure there is an airtight installation consistent with §150.0(k)8. This allows the building inspector to know what method the luminaire manufacturer specifies to achieve airtight installation, and therefore, at what phase of construction the building inspector shall inspect the luminaire for airtight compliance.
2. One of the following primary methods is specified by the luminaire manufacturer to insure an airtight seal of the certified airtight housing to the ceiling:
  - a. A gasket is attached to the bottom of the certified airtight housing prior to the installation of the ceiling (i.e. drywall or other ceiling materials) to create an airtight seal. The gasket may be preinstalled at the factory, or may need to be field installed. For field installed gaskets, instructions on how the gasket is to be attached shall be provided by the manufacturer. The luminaire shall be installed so that the gasket will be sufficiently compressed by the ceiling when the ceiling is installed. A gasket that is too thin will not provide an airtight seal.
  - b. A gasket is applied between the certified airtight housing and the ceiling opening after the ceiling has been installed. The gasket creates the airtight seal. The cut sheet and installation instructions for achieving the airtight conditions shall indicate how the gasket is to be attached.
  - c. Caulk is applied between the certified airtight housing and the ceiling after the ceiling has been installed. The caulk creates the airtight seal. The cut sheet or installation instructions for achieving the airtight conditions shall specify the type of caulk that must be used and how the caulk shall be applied.
  - d. A certified airtight trim kit is attached to the housing after the ceiling has been installed. The certified airtight trim kit in combination with the luminaire housing makes the manufactured luminaire airtight.

Note that a decorative luminaire trim that is not ASTM E283 certified does not make the manufactured luminaire airtight. Most decorative luminaire trims are not designed to make a luminaire airtight. Rather, these trims are used to provide a finished look between the ceiling and luminaire housing, and may include a reflector, baffle, and/or lens.

However, some trim kits are specifically designed to be a critical component used to make a luminaire installation airtight. These trim kits shall be certified airtight in accordance with ASTM E283. Certified airtight trim kits typically consist of a one-piece lamp-holder, reflector cone, and baffle.

The cut sheet and installation instructions for achieving the airtight conditions shall show which certified airtight trim kits are designed to be installed with the luminaire housing, and how the certified airtight trim kits shall be attached. A gasket shall be installed between the certified airtight trim kit and the ceiling.

3. The following methods for insuring an airtight seal between the certified airtight housing or certified airtight trim and the ceiling shall be field verified at different phases during construction:
  - a. A gasket attached to the bottom of the certified airtight housing shall be inspected prior to the installation of the ceiling when the rough-in electrical work is visible.

The inspector shall review the cut sheet or installation instructions to make sure the housing and gasket have been installed correctly.

All gaskets shall be permanently in place at the time of inspection. It is important that once the ceiling material is installed the gasket will be in continuous, compressed contact with the backside of the ceiling and that the housing is attached securely to avoid vertical movement.

The housing shall be installed on a plane that is parallel to the ceiling plane to assure continuous compression of the gasket.

- b. A gasket applied between the certified airtight housing and the ceiling after the ceiling has been installed shall be inspected after the installation of the ceiling.

The inspector shall review the cut sheet or installation instructions to make sure the housing and gasket have been installed correctly.

The gasket shall be permanently in place at the time of inspection. It is important that the gasket is in continuous, compressed contact with the ceiling, and that the housing is attached securely to avoid vertical movement.

- c. Caulk applied between the certified airtight housing and the ceiling after the ceiling has been installed shall be inspected after the installation of the ceiling.

The inspector shall review the cut sheet or installation instructions to make sure the housing has been installed correctly and the caulk has been applied correctly. It is important and that the housing is attached securely to avoid vertical movement.

- d. A certified airtight trim kit shall be inspected after the installation of the ceiling and the installation of the trim.

The inspector shall review the cut sheet or installation instructions to make sure the luminaire housing and the certified airtight trim kit have been installed correctly. It is important that the housing and the certified airtight trim kit are attached securely to avoid vertical movement.

The ASTM E283 certification is a laboratory procedure where the trim kit is tested on a smooth mounting surface. However, it is common for certified airtight trim kits to be installed against a textured ceiling or other irregular ceiling surface. It is important that the gasket is in continuous, compressed contact with the ceiling and the certified airtight trim kit. Therefore, it is important to visually inspect the certified airtight trim kit and gasket next to the ceiling to assure that a continuous seal has been produced.

Certified airtight trim kits may be installed on luminaire housings that may or may not be certified airtight. If the trim kit is certified airtight, it shall also have a sealed gasket between the trim kit and ceiling.

#### **6.3.14 Recommendations for Luminaire Specifications**

It is important that luminaires are described fully in the specifications and on drawings so that contractors and subcontractors provide and install residential lighting systems that comply with the residential lighting Standards. The specifications should be clear and complete so that contractors understand what is required to comply with the Standards.

Following are a few suggestions to help reduce the chance that there may be costly change orders required to bring a non-complying building into compliance.

- A. Include all applicable residential lighting requirements in the general notes on the drawings and other bid documents.
- B. Include the residential lighting requirements with each luminaire listed in the lighting schedule text and details, for example:

*Table 6-4 –Recommendations for Luminaire Specifications*

<b>Luminaire Type</b>	<b>Recommended Type of Notes for Luminaire Schedule</b>
Bath Bar	Bath bar, GU-24 sockets rated for use with only LED lamps.
Ceiling fixture (i.e., for a bathroom application)	Fluorescent surface-mounted ceiling luminaire, with one F32-T8 fluorescent lamp and electronic ballast, meeting the requirements of §150.0(k).
LED Recessed Can (i.e., for a kitchen application)	LED recessed can certified by the manufacturer to the Energy Commission, housing rated only for use with LED and not containing incandescent sockets of any kind, meeting the IC, and airtight requirements of §150.0(k).
Incandescent Recessed Can (i.e., for a Kitchen application)	Low-voltage recessed can with a maximum relamping wattage of 50 W, meeting the labeling, IC, and Airtight requirements of §150.0(k).
Chandelier	Chandelier, controlled by a dimmer switch meeting the requirements of §150.0(k) where the dimmer is certified to the Energy Commission by the manufacturer.
Vacancy Sensor (Manual-on Occupant Sensor)	Vacancy sensor certified to the Energy Commission by the manufacturer.

## 6.4 Calculating Kitchen Wattage and Classifying Luminaires

§150.0(k)3; §150.0(k)8, §130.0(c)

This section contains a summary of §130.0(c) of the Standards as it relates to residential lighting. This information is used to determine luminaire classification for all permanently installed luminaires, and to determine input power in residential kitchens.

The residential lighting Standards require luminaire input power (wattage) to be determined only in kitchens.

There are two different luminaire classifications that need to be considered for complying with residential lighting Standards.

- First, all luminaires, regardless of the type of room in which they are installed, need to be classified as high or low efficacy as described in sections 6.3.2 and 6.3.3 of this chapter. This classification will determine how the luminaire will be treated in §150.0(k) of the Standards.
- Second, if the luminaire is to be installed in a kitchen, the luminaire needs to be classified according to lighting technology in accordance with §130.0(c) to determine luminaire input watts. See sections 6.4.1 through 6.4.8 of this chapter.

If the luminaire is to be installed in a kitchen, luminaire input wattage need to be determined as follows:

- Luminaires need to be labeled in accordance with section 6.4.1 of this chapter.
- Wattage shall be determined in accordance with sections 6.4.2 through 6.4.8 of this chapter (§130.0(c) of the Standards).

### 6.4.1 Luminaire Labeling Requirements

The Lighting Standards determine installed lighting power by using the maximum relamping rated wattage of the luminaire.

The Standards require that the maximum relamping rated wattage shall be listed on a permanent, pre-printed, factory installed label, as specified by UL 1574, 1598, 2108, or 8750, as applicable. Labels shall meet the following requirements:

The factory-installed maximum relamping rated wattage label shall not consist of peel-off or peel-down layers or other methods that allow the rated wattage to be changed after the luminaire has been shipped from the manufacturer.

**EXCEPTION:** Peel-down labels may be used ONLY for luminaires that are manufactured, rated, and designed to meet ALL of the following requirements:

- A. The luminaire must be one that can accommodate a range of lamp wattages without changing the luminaire housing, ballast, transformer or wiring, and
- B. The luminaire can only operate one lamp, and
- C. The luminaire has an integrated ballast or transformer, and
- D. The peel-down labels shall be layered such that the rated wattage reduces as successive layers are removed and,
- E. The luminaire is capable of using only one of the following three lighting technologies:

1. High intensity discharge luminaire, having an integral electronic ballast, with a maximum relamping rated wattage of 150 watts, or
2. An individual low-voltage luminaire (low voltage track systems do not qualify to use this labeling method),  $\leq 24$  volts, with a maximum relamping rated wattage of 50 watts, or
3. Compact fluorescent luminaire, having an integral electronic ballast, with a maximum relamping rated wattage of 42 watts.

#### 6.4.2 Incandescent Luminaires

- A. The Standards classify all luminaires with line voltage screw-base sockets as incandescent. This includes all types of medium screw base incandescent lamp.
- B. For determining input power for incandescent luminaires, use the maximum relamping rated wattage of the luminaire in accordance with the labeling requirements discussed in section 6.4.1 of this chapter.

For recessed luminaires with line-voltage medium screw base sockets, the input wattage shall never be calculated as less than 50 watts per socket, even if the relamping rated wattage on a label is less than 50 watts.

- C. Luminaires and luminaire housings designed to accommodate a variety of trims or modular components that allow the conversion between incandescent and any other lighting technology without changing the luminaire housing or wiring shall always be classified as incandescent.
- D. Screw-based adaptors are never recognized as converting an incandescent luminaire to any type of non-incandescent technology. Screw-based adaptors, including screw-base adaptors classified as permanent by the manufacturer, are never recognized for compliance with the lighting Standards.
- E. Luminaires and luminaire housings manufactured with incandescent screw base sockets shall be classified only as incandescent.
- F. Field modifications, including hard wiring of an LED module into an incandescent luminaire or luminaire housing, shall not be recognized as converting the incandescent luminaire or luminaire housing to a non-incandescent technology for compliance with the residential lighting Standards, except for very specific alterations of preexisting luminaires as described in section 6.3.1 E of this chapter. For example, LED lighting modules having incandescent bases, or having incandescent pit-tails, shall not be recognized as LED for compliance with the Standards.

#### 6.4.3 Fluorescent and High Intensity Discharge (HID) Luminaires

- A. Both fluorescent and high intensity discharge (HID) lighting requires ballasts to operate. Therefore, luminaires with installed ballasts are either fluorescent (pin-based linear fluorescent or pin-based compact fluorescent) or HID (metal halide or high pressure sodium).
- B. For determining input power for fluorescent and HID luminaires, the input watts shall be the rated lamp/ballast combination used in the luminaire, as published in the ballast manufacturer's catalogs based on independent testing lab reports as specified by UL 1598.

- C. For fluorescent luminaires, this applies only to luminaires that are manufactured, rated, and designed for use with only pin-base fluorescent lamps, Screw-based compact fluorescent lamps do not qualify as fluorescent luminaires.
- D. For linear LED lamps, when installed in luminaires that are manufactured, rated, and designed for use with pin-base fluorescent lamps, such LED lamps shall not be recognized as converting the fluorescent luminaire to an LED luminaire.

#### 6.4.4 Track Lighting

Track Lighting is a system that includes luminaires and a track, rails, or cables that serve to both mount the system, and deliver electric power. There are two different type of track lighting typically used in residential kitchens: Line-voltage and Low-voltage track lighting.

As shown in Table 6-1, track lighting is always classified as low-efficacy incandescent lighting, regardless what lighting technology is actually installed on the track.

##### A. Line-Voltage Track Lighting

There is a menu of options available for determining the lighting power of line-voltage track lighting. Following are three options available for determining line-voltage track lighting input wattage when installed in residential kitchen lighting:

1. Use the volt-ampere rating of the branch circuit feeding the track; or
2. Use the higher the following two options:
  - a. The rated wattage of all of the luminaires included in the system, where wattage is determined according to §130.0(c), or
  - b. 45 watts per linear foot of track, or
3. When using a line-voltage track lighting integral current limiter, use the higher of the following two options:
  - a. The volt-ampere rating of an integral current limiter controlling the track or busway, or
  - b. 12.5 watts per linear foot of track or busway.

Note that only an Integral current limiter that has been certified by the manufacturer to the Energy Commission (§110.9) shall be recognized for determining track lighting wattage. An integral current limiter not certified to the Energy Commission shall not be recognized for compliance with the Standards. See section 6.5 of this chapter for additional information about certification requirements.

##### B. Low-voltage track lighting

A low-voltage track lighting system is equipped with a remote transformer for use with low-voltage equipment along the entire length of track. The wattage of low-voltage track lighting shall be the maximum rated input wattage of the transformer, as further explained in section 6.4.5 of this chapter.

#### 6.4.5 Low Voltage Lighting

Low-voltage lighting includes luminaires and lighting systems with permanently installed or remotely installed transformers.

The wattage of low-voltage lighting shall be determined as follows:

- A. For low-voltage luminaires that do not allow the addition of lamps, lamp holders, or luminaires without rewiring, the wattage shall be the rated wattage of the lamp/transformer combination.
- B. For low-voltage lighting systems which allow the addition of lamps, lamp holders, or luminaires without rewiring (such as low voltage track lighting), the wattage shall be the maximum rated input wattage of the transformer.

#### 6.4.6 LED Luminaires and Light Engines

§130.0(c)9

- A. LEDs that have been certified to the Energy Commission by the manufacturer as high efficacy are the only LED luminaires recognized being “high efficacy”. LEDs that are not certified to the Energy Commission are automatically classified as low efficacy, regardless of their actual efficacy.
- B. For use in residential kitchens, LED wattage shall be calculated using one of the methods below:
  - 1. For stand-alone LED luminaires or light engines (stand-alone means you cannot add LEDs) the installed lighting power shall be the rated wattage of the installed system, when wattage has been determined by the manufacturer in accordance with IES LM-79-08.
  - 2. For LED systems that do allow additional LEDs to be connected without rewiring, the installed lighting power shall be the maximum rated input wattage of the power supply.
  - 3. For luminaires that use LED lamps (either integrated- or non-integrated type) installed lighting power shall be calculated as incandescent luminaires.
  - 4. Luminaires manufactured or rated for use with line-voltage or low-voltage incandescent lamps, into which LED modules or LED lamps have been installed, shall not be recognized as LED lighting systems.

See sections 6.3.7, and 6.9 of this chapter for additional information about residential high efficacy lighting.

#### 6.4.7 Miscellaneous Lighting Systems

§130.0(c)10

This method applies only to lighting systems which have not been addressed by another subsection of §130.0(c), and is primarily intended to address new technologies that have been introduced after the Standards were adopted. This method shall not be applied to incandescent, fluorescent, HID, or LED luminaires because these lighting technologies have already been addressed in §130.0(c).

The wattage of all other miscellaneous lighting equipment shall be the maximum rated wattage of the lighting equipment, or operating input wattage of the system, listed on a permanent, pre-printed, factory-installed label, or published in manufacturer’s catalogs, based on independent testing lab reports as specified by UL 1574 or UL 1598.

### 6.4.8 Blank Electrical Boxes

§150.0(k)1C

In residential kitchens, the installed lighting power of electrical boxes finished with a blank cover or where no electrical equipment has been installed, and where the electrical box can be used for a luminaire or a surface mounted ceiling fan, shall be calculated as 180 watts of low efficacy lighting per electrical box.

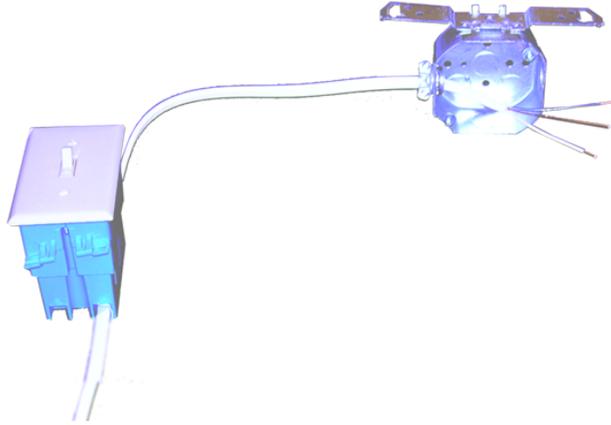


Figure 6-6 – Blank Electrical Box

## 6.5 Requirements for Switching Devices and Controls

The use of lighting controls is an important component of the residential lighting Standards. This section describes lighting control requirements for the residential lighting Standards.

### 6.5.1 Certification of Residential Lighting Controls

Manual-on/automatic-off occupant sensors (also known as vacancy sensors), motion sensors, photocontrols and astronomical time clock controls(used for outdoor lighting), track lighting integral current limiters, and dimmers installed to comply with §150.0(k) shall be certified according to the applicable requirements of the Title 20 Appliance Standards, as described in §110.9.

Additional information about certifying devices to the Energy Commission is in section 6.2 of this chapter.

### 6.5.2 Lighting Control Switching Requirements

Following are controls that are required for compliance with the residential lighting Standards:

#### A. Permanently Installed Luminaires

All permanently installed high efficacy luminaires shall be switched separately from low efficacy luminaires.

#### B. Exhaust Fans

There are two options for the switching of lighting associated with exhaust fans:

1. All lighting shall be switched separately from exhaust fans, or
2. For an exhaust fan with an integral lighting system, it shall be possible for the lighting system to be manually turned on and off while allowing the fan to continue to operate for an extended period of time.

An exhaust fan may need to run continuously if used to comply with §150.0(o).

#### C. Readily Accessible Manual Controls

All permanently installed luminaires shall be switched with readily accessible controls that permit the luminaires to be manually switched on and off.

#### D. Manufacturer Instructions

All lighting controls and equipment shall be installed in accordance with the manufacturer's instructions.

#### E. Multiple Switches

This requirement applies to all 3-way, 4-way, and other lighting circuits controlled by more than one switch. A lighting circuit controlled by more than one switch where a dimmer or vacancy sensor has been installed to comply with §150.0(k) shall meet the following conditions:

1. No controls shall bypass the dimmer or vacancy sensor function, and

2. The dimmer or vacancy sensor shall be certified to the Energy Commission that it complies with the applicable requirements of §119.

### 6.5.3 Lighting Control Systems and Energy Management Control Systems

§110.9

Lighting control devices may be either individual devices or systems consisting of two or more components. Lighting control systems and Energy Management Control Systems (EMCS) must meet the requirements of §110.9. There is no need for lighting control systems to be certified to the Commission. However, when installing a lighting control system, a licensee of record must sign a lighting control Certificate of Installation.

See section 6.2.2 of this chapter for more information about lighting control systems.

### 6.5.4 Vacancy Sensors

§150.0(k) and 110.9

- A. The residential lighting Standards require the installation of high efficacy lighting, but allow vacancy sensors to be used as an alternate compliance option in some room types.

See section 6.6 of this chapter to identify rooms where vacancy sensors may be used to comply with the residential lighting Standards.

- B. Manual-on/automatic-off occupant sensors, also known as vacancy sensors, automatically turn lights off if an occupant forgets to turn them off when a room is unoccupied.

- C. Additionally, these sensors are required to provide the occupant with the ability to manually turn the lights:

- Off upon leaving the room, and
- Off while still occupying a room, and
- On upon entering the room.

The manual-off feature is critical because it provides the occupants with the flexibility to control the lighting environment to their satisfaction, and results in greater energy savings by allowing the occupants to turn off the lights when they are not needed.

- D. Vacancy sensors are required to be certified by the manufacturer to the Energy Commission in accordance with the requirements in the Title 20 Appliance Efficiency Regulations before they can be sold or offered for sale in California.

See section 6.2 of this chapter for more information about certifying lighting control devices.

- E. If there are rooms or areas where there are safety concerns regarding the use of vacancy sensors, then the use of “dual technology” (infra-red plus ultrasonic) may be desirable, or alternatively the vacancy sensor may be staged to partially shut off the lighting before switching it off completely.

- F. Vacancy sensors commonly on the market are wired in two different ways:

1. Where sensor operating current uses the load connection (two-wire connection).

2. Where sensor operating current uses a neutral connection (three-wire connection).

Some vacancy sensors using the load connection for operating current have minimum load requirements.

For example, a vacancy sensor may require that bulbs rated over 25W be installed before the sensor will work. However, if an occupant later installs a screw-in compact fluorescent lamp that is rated less than 25W, the sensor may no longer work.

Therefore, it is critical to select a sensor that has a low enough minimum load requirement to accommodate however small a load the occupant may install into the socket. The sensors that have a minimum load requirement are typically the ones that are designed to operate without a neutral wire in the switch box which is a common wiring scheme in older residential units.

A better solution would be to install a vacancy sensor that does not have minimum load requirements.

Vacancy sensors that are designed to take advantage of the neutral wire in the switch box typically do not have a minimum load requirement and are the preferred choice to meet the requirements of the residential lighting Standards.

Using vacancy sensors that uses the ground wire for the operating current is not recommended. There are potential safety concerns with using the ground to carry current in residential applications.

If you are trying to control a lighting fixture from two different switches you may want to use a ceiling mounted rather than a wall switch occupant sensor, or use 3-way vacancy sensors at both switch locations.

#### Example 6-2: Bathroom vacancy sensors—automatic on

##### Question

In addition to one high-efficacy luminaire, we would like to use incandescent lighting in a bathroom, controlled by a vacancy sensor. Although the vacancy sensor has the “manual-on” capability, it also has the capability of turning the lights on automatically by flipping a switch that is located under the switch plate cover. Does this sensor meet the requirements of the residential lighting Standards?

##### Answer

No, this vacancy sensor does not meet the requirements of the Standards. The Title 20 Appliance Efficiency Regulations, and §110.9 of the Standards require that the vacancy sensor shall not have an override switch that converts the sensor from a manual-on to an automatic-on system. Such vacancy sensors cannot be sold in California according to the Title 20 Appliance Efficiency Regulations.

#### Example 6-3: Bathroom vacancy sensors--manual off

##### Question

Must the vacancy sensor in the example above give the occupant the option of turning the light off manually upon leaving the bathroom?

##### Answer

Yes. The vacancy sensor must provide the occupant with the option to turn the lights off manually upon leaving the space.

If the occupant forgets to turn the lights off when a room is left unoccupied then the vacancy sensor must turn the lights off automatically within 30 minutes.

The lights must then be manually switched back on when the lights are needed again. This option provides the occupants with the flexibility to control the lighting environment to their satisfaction, and results in greater energy savings by allowing the occupants to turn off the lights when they are not needed.

Example 6-4: Can auto-on occupancy sensors be used?

**Question**

What are our options if we want to use an automatic-on occupant sensor in a bathroom, garage, laundry room, or utility room?

**Answer**

Automatic-on occupant sensors are not allowed under the residential lighting Standards.

### 6.5.5 Residential Dimmers

- A. Dimmers are one of the alternate options to using high efficacy lighting in any room that is not a kitchen, bathroom, garage, laundry room, closet greater than 70 ft<sup>2</sup>, or utility room.  
See section 6.6.4 of this chapter for additional information.
- B. Dimmers are required to be certified by the manufacturer according to the Title 20 Appliance Efficiency Regulations. See section 6.2 of this chapter for more information about certifying lighting control devices.
- C. It is important to correctly match the dimmer with the type of lighting load that is being dimmed. Failure to correctly match the dimmer with the electrical lighting load may result in early equipment failure, including the dimmer, transformer, ballast, or lamp.  
This is especially important with LED lighting; a dimmer with the appropriate power range should be chosen, to match the total wattage of lighting it controls.
- D. Dimmer manufacturers typically offer three basic types of incandescent dimmers:
  - 1. Line voltage (120 volt), and
  - 2. Low-voltage for use with a magnetic transformer, and
  - 3. Low-voltage for use with an electronic transformer.

Line voltage incandescent lamps, including tungsten-halogen lamps, can easily be dimmed over their full range of output with voltage control or phase control (electronic) dimmers, generally without any special considerations.

When dimming a low voltage load, additional components are required in the dimmer to avoid overheating the transformer. UL has separate requirements for 120-volt and low-voltage dimmers due to the heat concern with transformers.

Example 6-5: Using dimmers on three-way lighting circuits

**Question**

In stairwells and some corridors, 3-way circuits are a common way to allow control of the lighting from either end of the space. How can I use dimmers to give a similar level of control?

**Answer**

In this case, the Standards require that the lighting must be controlled by at least one dimmer. It is functionally preferable to have dimmers at every point.

However, the Standards do not require that every control point must allow dimming. One of the switches could be a dimmer and the other could be a regular toggle switch. Alternatively, more advanced controls are available that allow dimming from both ends of the circuit.

However, the toggles switch(es) must not allow the lighting to come on at a higher level than is set by the dimmer.

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## 6.6 Requirements for Specific Indoor Space Types

### 6.6.1 Residential Kitchen

§150.0(k)3

The Standards define a residential kitchen as a room or area used for food storage and preparation and washing dishes including associated counter tops and cabinets, refrigerator, stove, oven, and floor areas.

Kitchen lighting includes all permanently installed lighting in the kitchen, except for lighting that is internal to cabinets for the purpose of illuminating only the inside of the cabinets. Lighting in areas adjacent to the kitchen, including but not limited to dining and nook areas, are considered kitchen lighting if they are not separately switched from kitchen lighting.

See section 6.3.1 of this chapter for a discussion of permanent versus portable lighting.

#### A. Determine High Efficacy and Low Efficacy Installed Wattage

§150.0(k)3A

The residential lighting Standards require that at least half of the rated lighting wattage installed in a kitchen shall be high efficacy luminaires.

For example, if 150W of high efficacy lighting is installed, no more than 150W of low efficacy lighting can be installed.

See sections 6.3.2 and 6.3.3 of this chapter for descriptions of high and low efficacy luminaires.

Because high efficacy luminaires typically consume less power than other luminaires, about three-fourths of the luminaires in the kitchen are likely to be high efficacy.

The Residential Lighting Certificate of Installation is required to be completed to determine if kitchen lighting complies with the Standards.

There are no limits to the total number of watts that can be installed in a residential kitchen. Therefore, there are no limits to illumination levels. If higher illumination levels are needed, simply install additional wattage from high efficacy luminaires until needed illumination levels are reached.

See section 6.4 of this chapter for information on determining the input power (wattage) of each installed luminaire.

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**Example 6-6: Kitchens: Wattage calculation****Question**

I am designing a residential kitchen lighting system where I plan to install six 26W compact fluorescent recessed downlights, and four 24W linear fluorescent under cabinet luminaires. Therefore, how many watts of incandescent lighting can I install?

**Answer**

First, determine the rated input watts of the fluorescent lighting system, including any additional wattage used by the ballasts. For this example, let's assume that the downlights with electronic ballasts are rated by the ballast manufacturer as consuming only 26W, and the under cabinet luminaires with electronic ballasts are rated by the ballast manufacturer as consuming 25W.

$$26 \times 6 = 156W$$

$$25 \times 4 = 100W$$

$$\text{Total} = 256W$$

Therefore, the maximum watts of incandescent lighting that can be installed is 256W.

**Example 6-7: Kitchens: Rated "relamping" wattage of luminaires****Question**

In the above example, if I plan to use 40W incandescent lamps (bulbs) in luminaires that have a relamping rated wattage of 90W, how many incandescent luminaires can I install?

**Answer**

The installed incandescent wattage is based upon the relamping rated wattage of the luminaire, and not by the wattage of the lamp. Two 90W incandescent luminaires = 180W, and three-90W incandescent luminaires = 270W. Because no more than 256W of low efficacy lighting can be installed in the above kitchen, only two-90W incandescent luminaires may be installed.

An additional 76W of low efficacy lighting may be installed somewhere else in the kitchen, provided that the total installed relamping rated wattage does not exceed the 76W still available.

Alternatively, four incandescent luminaires with a manufacturers labeled maximum relamping rated wattage of 60 watts (240W total) can be installed in the kitchen.

**Example 6-8: Kitchens: Rated wattage of transformers****Question**

In the above example, if I plan to use low-voltage incandescent halogen lamps with individual transformers rated at 40W each (in this example, let's assume that 40W includes the input wattage of the transformer + the lamp), how many of these low-voltage incandescent luminaires can I install?

**Answer**

The installed of low-voltage lighting is based upon the rating of the transformer. You are allowed up to 256W of low efficacy lighting

$$256 \text{ divided by } 40 = 6.4 \text{ luminaires}$$

You are allowed to install 6 low-voltage incandescent halogen luminaires with transformers rated at 40W each.

**Example 6-9: Kitchens: Use of luminaires that are not certified to the Commission****Question**

In the previous example, if I plan to use 15W LED luminaires which has not been certified to the Energy Commission as high efficacy, how many of these LED luminaires can I install?

---

**Answer**

LED lighting, which has not been certified by the Energy Commission as high efficacy, shall be classified as low efficacy lighting. The installed LED system wattage must include transformers, power supplies, and any other power consuming components. You are allowed up to 256W of low efficacy lighting.

In this example, let's assume a system input wattage of 15W per LED luminaire:

256 divided by 15 = 17 luminaires

You are allowed to install 17 low efficacy LED luminaires with system input wattage of 15W each.

NOTE: There would be no limit on the number of LED luminaires that could be installed, if they had been certified to the Energy Commission as high efficacy.

Example 6-10: Definition of high efficacy lighting

**Question**

I am using an incandescent luminaire over a sink that is rated to take a 60W lamp. The luminaire has a screw-base socket and I plan to install a 26W compact fluorescent lamp. Does this qualify as a high efficacy luminaire and what wattage should I use in determining if half the lighting power in the kitchen is high efficacy?

**Answer**

No, the luminaire does not count as high efficacy because it is capable of being lamped with an incandescent lamp. Use the maximum rated power (60W) for determining the percent of high efficacy lighting. If the maximum rating of the luminaire is less than 50W, it counts as a 50W luminaire for the purpose of lighting wattage calculations.

If this luminaire were manufactured with only a GU-24 twist-lock socket, and no screw-base sockets, it would be classified as a high-efficacy luminaire. Note that adaptors that convert screw-base sockets to GU-24 sockets are not recognized for compliance with the lighting Standards.

Example 6-11: Kitchens: Track lighting power calculation

**Question**

If I use track lighting in a kitchen, how do I calculate the power?

**Answer**

See §130(d) of the Standards, or section 6.4.4 of this chapter. For line voltage track, use the maximum relamping wattage of all of the installed luminaires as listed on permanent factory-installed labels, or 45W/linear feet of track, whichever is larger. If a line-voltage integral current limiter is used, use 12.5W/linear feet of track, or the volt-ampere rating of the current limiter (if the current limiter is certified to the Commission), whichever is lower.

For low-voltage tracks, use the maximum rated input wattage of the transformer as listed on a permanent factory-installed label.

Example 6-12: Kitchens: Boundary between kitchen and other rooms

**Question**

Where does the kitchen lighting stop and the other lighting begin in the case of a large family room with the kitchen on just one side of an approximately 24-ft by 24-ft room. Is the kitchen nook part of the kitchen? Lighting over the eating counter? Lighting in an adjacent pantry?

**Answer**

Lighting over food preparation areas is kitchen lighting, including areas used for cooking, food storage and preparation and washing dishes, including associated countertops and cabinets, refrigerator, stove, oven, and floor areas. Any other lighting on the same switch is also kitchen lighting, whether or not the luminaires are in the kitchen area. Lighting for areas not specifically included in the definition of a kitchen, like the nook or the family room, is not kitchen lighting, as long as it is switched separately.

**Example 6-13: Kitchens: Extraction hood lighting****Question**

I am installing an extraction hood over my stove, it has lamps within it. Do these lamps have to be high efficacy?

**Answer**

This lighting is part of an appliance, and therefore does not have to meet the residential lighting Standards for permanently installed lighting. This lighting is ignored in determining if half the kitchen lighting is high efficacy.

**B. Kitchen Low Efficacy Tradeoff Option**

*Exception to §150.0(k)3*

There is a residential kitchen lighting “tradeoff” option available when additional low efficacy lighting is needed, provided that other conditions are met.

Once it has been determined that the installed low efficacy lighting wattage is no greater than the installed high efficacy wattage, a limited number of additional low efficacy lighting wattage may be installed. The additional low efficacy wattage shown below in Table 6-5 – Additional Low Efficacy Wattage Tradeoff may be installed provided that all lighting in the kitchen (including the high efficacy lighting) is controlled by vacancy sensors, dimmers, or by a lighting control system that provides one or both of those functions.

See section 6.2 of this chapter for requirements to certify lighting controls.

*Table 6-5 – Additional Low Efficacy Wattage Tradeoff*

Size of Individual Dwelling Unit	Additional low efficacy lighting allowed in a residential kitchen
Less than or equal to 2,500 ft <sup>2</sup>	Up to an additional 50 W
Larger than 2,500 ft <sup>2</sup>	Up to an additional 100 W

**Example 6-14: Kitchens: Additional low-wattage allowances****Question**

I am designing kitchen lighting for a 2,400 ft<sup>2</sup> house. My design exceeds the 50% low efficacy lighting ratio in my kitchen. This design includes 208W of high efficacy lighting. I plan to control the high efficacy lighting in the kitchen with a vacancy sensor, and the low efficacy lighting in the kitchen with a dimmer. How many watts of low efficacy lighting can I install in my kitchen?

**Answer**

You are allowed an additional 50W of low efficacy lighting in the kitchen because the house is less than 2,500 ft<sup>2</sup>. You are also allowed 208W of low efficacy lighting based upon the wattage of high efficacy lighting you are installing.

$$50W + 208W = 258W.$$

You are allowed to install up to 258W of low efficacy lighting in the kitchen.

**C. Lighting Internal to Cabinets**

Lighting mounted to a cabinet for the purpose of projecting light somewhere other than the inside of the cabinet shall be considered as kitchen lighting when determining that at least 50% of the permanently installed lighting is high efficacy. For examples, indirect lighting mounted to the top of a cabinet for illuminating the ceiling, light projected from within a cabinet onto a surface outside of a cabinet, and under cabinet lighting, are all types of lighting that are required to be counted toward the 50% residential kitchen lighting high efficacy versus low efficacy lighting.

However, lighting internal to cabinets, installed only for the purpose of illuminating the inside of the cabinets, is not considered kitchen lighting when determining that at least 50% of the permanently installed lighting in a residential kitchen is high efficacy.

Permanently installed lighting that is internal to cabinets shall use no more than 20 W of power per linear foot of illuminated cabinet.

See section 6.3.1 of this chapter for more information about permanently installed lighting.

This linear footage can be determined using any one of the following methods, regardless of the number of shelves or cabinet doors:

1. The total horizontal length of illuminated cabinets
2. The sum of the heights of each separate illuminated cabinet section
3. The sum of several height measurements, taken no closer than 40" from each other.

The third method is recommended when illuminating several cabinets that are of different heights. Figure 6-7 –6-7 shows that one vertical measurement can be taken per 40" length of illuminated cabinet. If any of the cabinets are not illuminated, they do not count toward the 40" length and should be skipped.

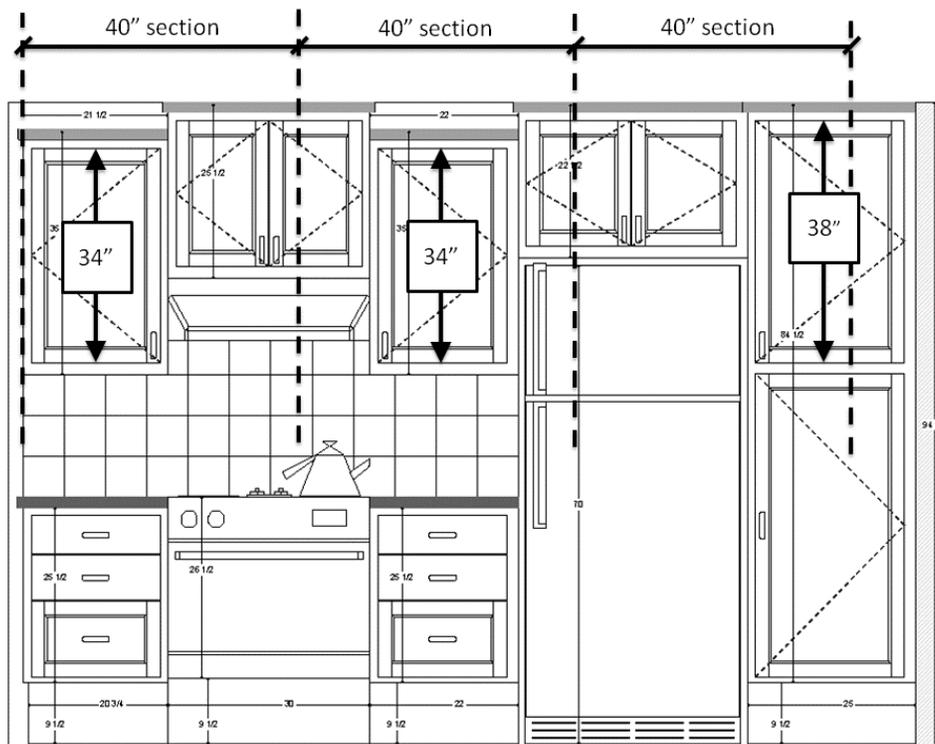


Figure 6-7 – Calculating the Linear Footage of Illuminated Cabinets Using Multiple Vertical Lengths

Lighting that is internal to cabinets is defined as lighting installed inside of a cabinet only for the purpose of illuminating the inside of the cabinet. Lighting installed for the purpose of illuminating surfaces outside of kitchen cabinet is not considered lighting internal to cabinets. The following lighting systems are not considered lighting internal to cabinets:

1. Lighting recessed into a cabinet for the purpose of illuminating surfaces outside of the cabinet.
2. Lighting attached to any surface on the outside of a cabinet, including the top, bottom, or sides.
3. Lighting attached to the inside of a cabinet, such as reflector lamps, for the purpose of projecting light out of the cabinet.

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**Example 6-15: Kitchens: Cabinet lighting, number of shelves****Question**

I have 23 linear feet of upper kitchen cabinets, and 32 linear feet of lower kitchen cabinets. I want to install lighting on the inside of three 6 foot sections of upper cabinet that are 30" tall, and which have glass doors. The upper cabinets have three shelves. I want to install lights under all three shelves. How many watts of lighting may I install in the cabinets?

**Answer**

The cabinet lighting allowance is based upon the linear footage of illuminated cabinet only, regardless of the number of shelves in each cabinet. There are three ways to calculate the allowance.

- i. Horizontal length, Multiply 18 ft times 20W per foot = 360W.
- ii. Number of illuminated sections. There are three separate sections of cabinet, each 30" tall. 3 times 30" = 90", times 20W per foot = 150W.
- iii. Height. Height can be measured once per 40" of horizontal length. The total 18' length, divided into 40" sections, gives 5.4 sections. Assuming that the height is uniformly 30", the total height is 5.4 times 30" = 162", times 20W per foot = 270W

Using the largest of the three answers, up to 360W of internal cabinet lighting could be installed.

**Example 6-16: Kitchens: Cabinet lighting, non-illuminated cabinets****Question**

In the above example, if I have 18 linear feet of upper cabinets with glass doors, but I only want to install lighting in 10 linear feet of the cabinets, how many watts of lighting may I install in the cabinets?

**Answer**

The allowance is based upon the linear feet of cabinet that is illuminated. In this case, multiply 10 ft time 20W/ft = 200W. You are allowed to install up to 200W of internal cabinet lighting.

**Example 6-17: Kitchens: Definition of cabinet lighting****Question**

In the above example, I am installing puck lights under the shelves of the cabinets with glass doors. Some of the lighting will inadvertently spill through the glass. Is this still considered lighting only for the purpose of illuminating the inside of the cabinets?

**Answer**

Yes, this is still considered lighting for the purpose of illuminating the inside of the cabinets because the lighting system is specifically designed for illuminating the inside of the cabinets. However, if a different lighting system, such as adjustable flood lights, is designed to project lighting on to surfaces external to the cabinets, that lighting will be considered permanently installed kitchen lighting, and not internal cabinet lighting.

#### D. Required Kitchen Lighting Controls

High-efficacy luminaires and low efficacy luminaires are required to be controlled separately. See section 6.5 of this chapter for additional information on residential lighting controls.

All high efficacy luminaires may be controlled together, and all low efficacy luminaires may be controlled together, but to give occupants more energy-saving options, each lighting layer that serves a unique function should have the ability to operate independently. The following are some recommendations for kitchen lighting controls:

1. Recessed downlights should be controlled separately from other lighting.
2. Linear fluorescent luminaires mounted on the ceiling should be controlled separately from other lighting.
3. Under-cabinet lighting should be controlled separately from other lighting.



*Under-cabinet lighting using 14W and 28W T5 linear fluorescent lamps*

Source: [www.gelighting.com](http://www.gelighting.com)

*Figure 6-8 – Kitchen Work Surface Lighting*

4. Uplights (mounted on walls or on top of cabinets) should be controlled separately from other lighting. Uplights are effective at making rooms less gloomy, so if an uplight is provided people may choose not to switch on the other lights in the room.

5. Task lighting for specific areas such as sinks or bars should be controlled separately.
6. Lighting in areas adjacent to the kitchen, such as dining and nook areas and even family rooms, is considered to be kitchen lighting if it is not separately switched from the kitchen lighting.

It is important that lighting in other rooms is separately switched from the kitchen lighting, or the lighting in the other room will need to be considered when determining if the kitchen complies with the 50% high efficacy lighting requirements.

The switches may be mounted on the same faceplate, but as long as the lights can be switched independently, these areas do not count as being in the kitchen.



*Recessed cans with 18W CFLs light specific task areas*



*Wall-mounted uplights using 32W CFLs increase the sense of space*

*Figure 6-9 – General Kitchen Lighting*

### E. Kitchen Lighting Alterations

The same lighting requirements apply to any kitchen lighting alterations, additions or renovations, as to newly constructed buildings.

The Standards do not recognize the conversion of incandescent luminaires to LED luminaires for any newly constructed buildings or additions. However, for specific residential lighting alterations, Light Emitting Diode (LED) modules may be hardwired into luminaire housings manufactured for use with incandescent lamps, and qualify as high efficacy luminaires provided ALL of the following conditions are met:

1. The luminaire has been previously used and is in its existing installation, and
2. The LED modules are not LED lamps, integrated or non-integrated type, as defined by ANSI/IES RP-16-2010 (this includes that they shall not have any type of screw base), and
3. The LED modules comply with all other requirements in §130.0(c), and
4. The LED modules are certified as high efficacy to the Energy Commission by the manufacturer in accordance with §110.9
5. The LED modules are not connected using screw-based sockets or screw-base adaptors.

Note that GU-24 sockets are not covered by an ANSI standard, and therefore are not classified as either “integrated” or “non-integrated” LED lamps under ANSI/IES RP-16-2010. Therefore LED retrofit modules with GU-24 bases qualify as high efficacy luminaires in retrofits.

Example 6-18: Kitchens: Calculating allowed wattage based on existing luminaires

#### Question

I am doing minor renovations to my kitchen that has six recessed incandescent cans and I am adding a new luminaire over the sink. Does this luminaire have to be a high efficacy luminaire?

#### Answer

Yes, all new luminaires must be high efficacy until at least 50% of the total lighting wattage comes from high efficacy luminaires (§150.2(b)1 and §150.2(b)2).

Example 6-19: Kitchens: Wattage calculation for a total remodel

#### Question

I am completely remodeling my kitchen and putting in an entirely new lighting system. How do the residential lighting Standards apply to this case?

#### Answer

All the same lighting Standards apply. This remodel is treated like newly constructed buildings.

### 6.6.2 Bathrooms

100.1 definitions, §150.0(k)5

- A. A bathroom is a room or area containing a sink used for personal hygiene, toilet, shower, or a tub.

- B. If a sink used for personal hygiene is in a room other than a bathroom, such as bedroom, where no doors, walls, or other partitions separate the sink area from the rest of the room, and the lighting for the sink area is switched separately from room area lighting, only the luminaire(s) that are lighting the sink area must meet the bathroom lighting requirements; in this case, lighting of the sink area includes lighting of associated counters, cabinets, and mirrors.
- C. Each bathroom shall have a minimum of one high efficacy luminaire. All other lighting in bathrooms shall be high efficacy or controlled by vacancy sensors.
- D. More than one circuit of luminaires may be attached to the same vacancy sensor.

Example 6-20: What types of vacancy sensors are eligible?

**Question**

What types of vacancy sensors qualify for controlling low efficacy lights in bathrooms?

**Answer**

Eligible vacancy sensors are those which have been certified by the manufacturer to the Energy Commission according to the Title 20 Appliance Efficiency Regulations. These vacancy sensors (manual-on / automatic-off occupancy sensors) do not allow the luminaire to be turned on automatically and do not have an override that allows it to remain on.

See section 6.5.4 of this chapter for more information about vacancy sensors.

Example 6-21: Vacancy sensor safety considerations

**Question**

Is it good lighting practice to have all the lighting in a room controlled by a single vacancy sensor?

**Answer**

Vacancy sensors may fail to detect people who aren't making large movements, and their sensitivity is reduced in hot environments. Vacancy sensors may cause the lights to switch off while someone is using a hazardous device. The required high efficacy luminaire in each bathroom, and any additional high efficacy luminaires in a bathroom are not required to be controlled by a vacancy sensor.

Example 6-22: Bathrooms: Medicine cabinet lighting

**Question**

Is the factory installed lighting system in a bathroom mounted medicine cabinet required to be either high-efficacy or controlled by a vacancy sensor?

**Answer**

If the factory installed lighting in a medicine cabinet is designed to only illuminate the inside of the medicine cabinet, and the lighting is controlled only by a door activated switch where the lights turn off automatically when the cabinet door is closed, then the factory installed lighting is not regulated by the residential lighting Standards. However, if the factory installed lighting is connected to a manually operated switch that can be turned on regardless of the position of the cabinet door, or the lighting is designed to illuminate or display the contents of the cabinet when the door is closed, then it is considered permanently installed lighting that must comply with the residential lighting Standards. Also, any factory installed "bath bar" or other general lighting system integrated into the medicine cabinet is considered permanently installed lighting that must comply with the residential lighting Standards.

### 6.6.3 Garages, Laundry Rooms, and Utility Rooms

§150.0(k)6

- A. Lighting in garages (attached and detached), laundry rooms, and utility rooms shall be high efficacy, **and** shall be controlled by vacancy sensors. See section 6.3.12 for information on residential lighting controls.
- B. A garage, for compliance with the residential lighting Standards, is a non-habitable building or portion of building, attached to or detached from a residential dwelling unit, in which motor vehicles are parked.

Garages present an opportunity to reduce energy use by providing task lighting. The end of the garage furthest from the door to the house is often used as a work area, and can be provided with high efficacy luminaires switched separately from the rest of the space.

Because people may be working in garages for long periods, and may be obscured by cars or other large objects, ultrasonic or dual-technology vacancy sensors may be preferred to standard passive infra-red vacancy sensors. Ultrasonic sensors can “see around corners” unlike infra-red sensors which are line-of-sight.

See section 6.3.1 of this chapter for information about when lighting integral to garage door openers does and does not have to be included as permanently installed lighting in a garage.

- C. A laundry room is a non-habitable room or space which contains plumbing and electrical connections for a washing machine or clothes dryer.
- D. A utility room is a non-habitable room or building which contains only HVAC, plumbing, or electrical controls or equipment; and which is not a bathroom, closet, garage, or laundry room.

#### Example 6-23: Vacancy sensor safety considerations

##### Question

Is it good lighting practice to have all the lighting in a room controlled by a single vacancy sensor?

##### Answer

Vacancy sensors may fail to detect people who aren't making large movements, and the sensitivity of passive infra-red vacancy sensors is reduced in hot environments. Also, passive infra-red sensors cannot “see around corners” like ultrasonic or microwave sensors can. In spaces in which someone may be using a hazardous device (such as garages) dual-technology sensors reduce the likelihood that the lights will switch off while the room is occupied. Alternatively, sensors which dim the lights before switching them off provide an additional level of security.

#### Example 6-24: Laundry rooms: built-in lighting for ironing boards

##### Question

Is the factory installed lighting in a built-in ironing board device required to be high-efficacy and controlled by a **vacancy sensor when it is installed in a laundry room?**

##### Answer

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Yes, if the lighting is permanently installed it must be high-efficacy and controlled by a vacancy sensor. See section 6.3.1 for additional information about permanently installed luminaires.

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#### 6.6.4 Other Rooms

§150.0(k)7

- A. “Other rooms” include any room or area that is not a kitchen, bathroom laundry, garage, or utility room.

Rooms which are classified as “other rooms” would include hallways, dining rooms, family rooms, club house, home office, bedrooms, attic spaces, and closets.

These tend to be the rooms in which people are most aware of interior design both in terms of fashion and the usability of their living space.

A closet defined as a non-habitable room used for the storage of linens, household supplies, clothing, non-perishable food, or similar uses, and which is not a hallway or passageway.

A storage building is defined as a non-habitable detached building used for the storage of tools, garden equipment, or miscellaneous items.

- B. Permanently installed lighting in any room classified as “other rooms” has three compliance options. The lighting shall be:

1. High efficacy, or
2. Controlled by a vacancy sensor, or
3. Controlled by a dimmer

See section 6.2 for residential lighting control requirements.

- C. Note that the dimmer compliance option is available only in rooms that qualify as “other rooms.” The Standards do not disallow or discourage the use of dimmers in any rooms; however dimmers shall not be recognized as a method of compliance with the residential lighting Standards for any kitchen, bathroom laundry, garage, or utility room.

- D. There are many rooms in houses for which permanently installed lighting has not been provided. Instead, these rooms are often provided with switched receptacles, sometimes called, “half-hots.” Many people commonly add their own portable lighting. Portable lighting is not regulated by the Title 24 residential lighting Standards. However, portable lighting is regulated by the Title 20 Appliance Efficiency Regulations.

See section 6.3.1 of this chapter for additional information about portable lighting.

Permanently installed can be used to create variations of light throughout the room, and by reducing areas of shadow. To achieve this, use several luminaires rather than a single luminaire; wall-mounted uplights are a good choice because they are design-neutral and can be repainted. For high-end properties, linear fluorescent or LED cove lighting and other forms of concealed lighting may increase marketability.

- E. Most people like to control the appearance of their rooms; providing separate switches for each layer of luminaires will make the space more attractive to tenants and will allow them to reduce their energy use.

F. Although vacancy sensors can be used in all living spaces, there are limitations in some living spaces where people are expecting to sit still for long periods of time and not move around enough to keep the sensor activated, resulting in lights going off prematurely.

**G. All Other Room Exceptions:**

1. Lighting in detached storage buildings that are less than 1000 ft<sup>2</sup>, when those storage buildings are located on a residential site, are not required to comply with §150.0(k)7.
2. Closets less than 70 ft<sup>2</sup> are also exempt from these requirements.

However, a hallway having storage shelves, such as a butler's cupboard, shall not be exempt because it is considered a hallway for compliance with the residential lighting Standards. A butler's cupboard is therefore not considered an exempt closet.

A closet is defined as a non-habitable room used for the storage of linens, household supplies, clothing, non-perishable food, or similar uses, and which is not a hallway or passageway.

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**Example 6-25: Ceiling fans with integrated lighting**

**Question**

Can a ceiling fan with integrated lighting be a high efficacy luminaire?

**Answer**

Yes. Ceiling fan light kits with integral CFL ballasts are available. Some LED lighting may qualify as high efficacy. LED lighting must be certified to the Energy Commission before it can be classified as high efficacy. See sections 6.2.3; 6.3.7; 6.4.6; and 6.9 for more information about requirements for residential LED lighting.

Some occupants are likely to prefer obscured lamps to visible lamps. A less efficient alternative, when the ceiling fan is installed in a room other than a kitchen, bathroom, garage, laundry room and/or utility room, is to use incandescent lamps on a dimming circuit separate to the fan circuit.

**Example 6-26: Best practice for high efficacy spotlights**

**Question**

Are high-efficacy spotlights available, to replace halogen MR16s?

**Answer**

Some CFLs resemble spotlights, and manufacturers may describe them as spotlights, but they produce the same diffuse light as regular CFLs.

Metal halide spotlights with 35W T-6 high efficacy lamps are available, and LEDs can be used as spotlights.

LED lighting must be certified to the Energy Commission before it can be classified as high efficacy. See sections 6.2.3; 6.3.7; 6.4.6; and 6.9 for more information about requirements for residential LED lighting.

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## 6.7 Requirements for Residential Outdoor Lighting

§150.0(k)9

Outdoor residential lighting is sometimes subject to the residential lighting requirements, and sometimes subject to the nonresidential lighting requirements. To help clarify the distinction, Figure 6-10 shows which requirements apply to various types of outdoor lighting for each building type.

Residential <sup>2</sup> Versus Nonresidential <sup>3</sup> Lighting Requirements				
Space type	Single-Family	Low-rise multifamily		High-rise Multifamily and Hotels
		1-3 Dwelling units	4 or more Dwelling units	
Private patios, entrances, balconies, porches; parking lots carports with fewer than eight vehicles per site	Residential	Residential or Nonresidential		Residential, if the lighting is separately controlled from the inside of a dwelling unit or guest room.  Otherwise, nonresidential
Residential parking garages <sup>1</sup> , lots and carports with more than eight vehicles per site	Nonresidential			
Other outdoor lighting attached to the building	Residential	Nonresidential		
Outdoor lighting not attached to a building	Not regulated		Nonresidential	
1. Residential parking garages with seven or fewer vehicles are covered by the indoor residential lighting requirements. 2. "Residential" means that the lighting shall comply with §150.0(k)9A 3. "Nonresidential" means that the lighting shall comply with §110.9, §130.0, §130.2, §130.4, §140.7, and §141.0 as applicable.				

Figure 6-10 – Applicability of Standards to Outdoor Lighting in Different Residential Building Types

### 6.7.1 Single-Family Buildings

All lighting attached to the residence or to other buildings on the same lot must be high efficacy, or controlled by a motion sensor and either a photocell or an astronomical time clock.

Lighting must be controlled by a manual on/off switch that does not override any automatic sensor to the "on" mode.

Motion sensors may have a temporary override function that keeps the luminaire switched on irrespective of whether motion is detected, but the sensor must default back to automatic operation after no longer than six hours.

An Energy Management Control System (EMCS) may be used if it complies with all these requirements.

Stand-alone lighting control devices are required to be certified to the Energy Commission in accordance with the Title 20 Appliance Standards. Lighting control systems shall meet all the applicable requirements of §110.9.

See sections 6.2.1 and 6.2.2 of this chapter for additional information about lighting controls.

### 6.7.2 Low-Rise Multifamily Buildings

- A. Low-rise multifamily buildings are subject to the same outdoor lighting requirements as single-family buildings, with the exception that outdoor lighting in the following areas is allowed to comply with either the single-family requirements or the nonresidential requirements:
1. Private patios
  2. Entrances
  3. Balconies
  4. Porches
  5. Residential parking lots and carports with fewer than eight vehicles
- B. Residential parking lots and carports with eight or more vehicles are required to meet the nonresidential outdoor lighting requirements.

### 6.7.3 High-Rise Multifamily buildings

Any outdoor lighting attached to the building, and which is controlled from within the dwelling unit, shall meet the residential requirements.

Outdoor lighting attached to the building that is not controlled from within the dwelling unit shall meet the nonresidential requirements. For information on the nonresidential requirements, see the outdoor lighting chapter for the 2013 Nonresidential Compliance Manual.

### 6.7.4 Address Signs

§150.0(k)10

**A. Internally illuminated address signs shall:**

1. Comply with the nonresidential sign lighting Standards in §140.8, or
2. Consume no more than 5 watts of power as determined according to §130.0(c).

**B. Other Signs**

For high-rise residential buildings and hotels, signs that are not inside the dwelling units or guest rooms shall comply with the applicable nonresidential Sign Lighting requirements in §130.3 and §140.8. For additional information, see the Sign Lighting chapter of the 2013 Nonresidential Compliance Manual.

### 6.7.5 Hot and Cold Environments

Amalgam CFLs perform better at both very high and very low temperatures than non-amalgam versions, so are appropriate for outdoor lighting, although they can take a few minutes to reach full output. CFLs and ballasts that are not labeled “instant start” are likely to be amalgam lamps. If instant start is important and temperatures may be low, specify a cold-weather-rated ballast.

Alternatively, an LED luminaire may be a good choice because LEDs perform very well in cold environments.

### 6.7.6 Outdoor Lighting Not Attached to a Building

§150.0(k)9

Lighting that is not permanently attached to single family and low-rise multifamily buildings with fewer than four dwelling units, such as decorative landscape lighting, is not regulated by the residential lighting Standards.

However, when landscape lighting is attached to a building, it is regulated by the residential lighting Standards.

For exempt lighting, using a time clock or photocontrol on outdoor lighting not attached to buildings will help to prevent people from accidentally leaving these lights on during the day and will reduce energy use.

#### Example 6-27: Outdoor lighting: Glare control

##### Question

Are there any “cutoff” requirements for residential outdoor luminaires?

##### Answer

There are no “cutoff” requirements for typical residential outdoor lighting. However, residential parking lots for eight or more vehicles are required to meet the Nonresidential Standards, which do include cutoff requirements for luminaires greater than 150W. The requirement uses the Backlight, Uplight and Glare (BUG) ratings developed by the IES to define acceptable amounts of the uplight and glare (there are no limits on “backlight”). Even though not required for most residential outdoor lighting, luminaires that limit uplight are usually more efficient at providing light in the required area, so a lower wattage lamp and ballast can be used. The BUG requirements also reduce stray light and glare problems which can cause visual discomfort.

#### Example 6-28: Outdoor lighting: Landscape lighting

##### Question

I would like to install low-voltage landscape lighting in my yard. Are these required to be on a motion sensor and photocontrol?

##### Answer

No. The high efficacy requirement only applies to lighting mounted to the building.

#### Example 6-29: Outdoor lighting: Patios

##### Question

Does outdoor lighting on the patio of a high-rise residential building have to comply with the Residential or Nonresidential Lighting Standards?

##### Answer

If the patio outdoor lighting is controlled from inside of the dwelling unit, it must comply with the Residential Outdoor Lighting Standards. If the patio outdoor lighting is controlled outside of the dwelling unit, it must comply with the Nonresidential Outdoor Lighting Standards. For example, if the outdoor patio lighting is controlled by a building-wide EMCS outside of the dwelling units, it must comply with the Nonresidential Outdoor Lighting Standards.

### 6.7.7 Residential Parking Lots, Carports and Parking Garages

§150.0(k)13; §130; §131; §132; §134; §146; §147.; §150.0(k)11

Residential parking garages are treated as indoor spaces, whereas residential parking lots and carports are treated as outdoor space. All three types of parking facilities are required to meet either the residential or the nonresidential requirements of the Standards, depending on what type of building they are associated with, as demonstrated in Figure 6-11.

Residential Indoor, <sup>1</sup> Residential Outdoor, <sup>2</sup> Nonresidential Indoor, <sup>3</sup> Nonresidential Outdoor <sup>4</sup>					
Space type	Number of car spaces	Single-family	Low-rise multifamily		High-rise multifamily and hotels
			Common area is 20% or less of interior space	Common area is >20% of interior space	
Parking garages	<8	Residential indoor		Nonresidential indoor	
	8 or more	Nonresidential indoor			
Parking lots and carports	<8	Residential outdoor	Residential outdoor, or nonresidential outdoor		Nonresidential outdoor
	8 or more	Nonresidential outdoor			

1. "Residential indoor" means that the lighting shall comply with §150.0(k)7 (see section 6.6.3).
2. "Residential outdoor" means that the lighting shall comply with §150.0(k)9 (see sections 6.7.6 and 6.7.7).
3. "Nonresidential" indoor means that the lighting shall comply with §110.9, §130.0, §130.1, §130.4, §140.6, and §141.0
4. "Nonresidential" outdoor means that the lighting shall comply with §110.9, §130.0, §130.2, §130.4, §140.7, and §141.0

Figure 6-11 – Applicability of Standards to Parking Facilities and Common Areas in Different Residential Building Types

Residential parking lots should be lighted uniformly to provide a sense of safety; this means that lighting should fill in shadows and dark corners. Two or more less powerful luminaires in different places are often preferable to a single luminaire.

The Nonresidential Outdoor Lighting Standards include the following requirements for parking lots and car ports that accommodate a total of eight or more vehicles per site:

1. Incandescent luminaires rated for lamps over 100W shall be controlled by a motion sensor. Outdoor luminaires with lamps rated over 150W must comply with the Backlight, Uplight, and Glare (BUG) requirements in §130.2 as established by the IES.
2. Luminaires shall be controlled by a photocontrol, or an astronomical time switch that turns the lighting off when daylight is available.

See the following sections for a complete view of the Nonresidential Outdoor Lighting Standards: §130.0, §130.2, §130.4, and §140.7.

#### Example 6-30: Parking spaces

##### Question

I have a low-rise multi-family complex with a total of 20 parking spaces. However, the parking spaces are arranged throughout the site in groups of only 4 spaces each. Are these parking spaces required to comply with the nonresidential outdoor lighting requirements?

##### Answer

Yes, these spaces are required to comply with the Nonresidential Outdoor Lighting Standards. Parking lots and carports for a total of eight or more cars per site must meet the nonresidential outdoor lighting requirements.

## 6.8 Common Areas of Multi-family Buildings

### §150.0(k)12

Common areas in multi-family buildings include areas like interior hallways, lobbies, entertainment rooms, pool houses, club houses, and laundry facilities.

Buildings of three stories or fewer are classified as low-rise. For buildings higher than three stories the Nonresidential Standards apply to all of the common areas.

- A. In low-rise multi-family buildings with four or more dwelling units where common areas are 20% or less of the building area, lighting for common areas must be high efficacy, or controlled by an occupant sensor. Occupant sensors used in common areas may have the capability of turning the lights on automatically.
- B. In buildings where common areas are more than 20% of the building area, lighting in those common areas must comply with the nonresidential lighting requirements in §110.9, §130.0, §130.1, §140.6, and §141.0.

The quality of light provided in common areas of apartments, condominiums, and townhouses should be particularly high, because older or visually impaired residents must be able to find their way safely through spaces that may contain unexpected obstacles. Providing a sufficient level of light is essential.

- C. Lighting in corridors and stairwells of multi-family buildings must be controlled by occupant sensors that reduce the lighting by at least 50%.

The lighting of staircases and stairwells is a particular safety concern; the best way to light stairs is with directional light from above, to maximize the contrast between treads and risers.

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Example 6-31: Multifamily common areas: Low rise

**Question**

Does the lighting for an interior common-area hallway of a low-rise residential building with four or fewer dwelling units have to comply with the Residential or Nonresidential Lighting Standards?

**Answer**

No, the lighting of an interior common-area hallway of a low-rise residential building with four or less dwelling units must comply with the residential lighting Standards.

Example 6-32: Multifamily common areas: High rise

**Question**

Does the lighting for an interior common-area hallway of a high rise residential building have to comply with the Residential or Nonresidential Lighting Standards?

**Answer**

The lighting of an interior common-area hallway of a high rise residential building must comply with the Nonresidential Lighting Standards. All the lighting in common areas must comply with the Nonresidential Standards; lighting inside the dwelling units must comply with the residential lighting Standards.

Hallways and stairwells are required to have partial on/off occupancy sensors that switch off at least half the lighting load when the hallway or stairwell is unoccupied.

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## 6.9 Requirements for Residential LED Lighting

The purpose of this section is to assemble all of the 2013 Title 24 Standards language related residential LED lighting into one place in this chapter.

To qualify as high efficacy for compliance with the residential lighting Standards, an LED luminaire or light engine must be certified to the Energy Commission by the manufacturer.

LEDs not certified in accordance with all of the requirements in the Standards shall be classified as low efficacy, regardless of their actual efficacy.

There are no requirements, opportunities, or provisions to certify nonresidential LED luminaires to the Energy Commission. Any LED luminaires which are not for residential applications, and which may have been certified to the Energy Commission, have been done so incorrectly by the manufacturer.

### 6.9.1 Certification Responsibilities

The following Standards language establishes that manufacturers are responsible to certify high efficacy LED light sources

#### §100.0(h)

Residential high efficacy LED light sources are required to be Certified to the Energy Commission, which requires them to be certified by the manufacturer in a declaration, executed under penalty of perjury under the laws of the State of California, that all the information provided pursuant to the certification is true, complete, accurate and in compliance with all applicable provisions of Part 6; and if applicable that the equipment, product, or device was tested under the applicable test method specified in Part 6.

#### §110.9(e)

To qualify as high efficacy for compliance with the residential lighting Standards in §150.0(k), a residential LED luminaire or LED light engine shall be certified to the Energy Commission according to Reference Joint Appendix JA-8. LED lighting not certified to the Energy Commission shall be classified as low efficacy for compliance with §150.0(k). Nonresidential LED lighting is not required to be certified to the Energy Commission.

### 6.9.2 Definitions

The following definitions in the Standards are relevant to the certification of high efficacy LED lighting sources.

#### §100.1(b)

Certified to the Energy Commission, means, when used in association with appliances, certified under §1606 of Title 20 of the California Code of Regulations; and otherwise means certified by the manufacturer in a declaration, executed under penalty of perjury under the laws of the State of California, that all the information provided pursuant to the certification is true, complete, accurate and in compliance with all applicable provisions of Part 6; and if applicable that the equipment, product, or device was tested under the applicable test method specified in Part 6.

Light Emitting Diode (LED) definitions used in Part 6 are in section 6.8 of ANSI/IES RP-16-10.

### 6.9.3 Classifying Luminaires and Determining Input Wattage

The following Standards language regulates how to classify luminaires as LED and how to determine input wattage.

#### §130.0(c)5

Luminaires and luminaire housings manufactured with incandescent screw base sockets shall be classified only as incandescent. Field modifications, including hard wiring of an LED module, shall not be recognized as converting an incandescent luminaire or luminaire housing to a non-incandescent technology for compliance with Part 6.

#### §130.0(c)6B

Replacement of lamps in a luminaire manufactured or rated for use with linear fluorescent lamps, with linear lamps of a different technology such as linear LED lamps, shall not be recognized as converting the fluorescent luminaire to a different technology for compliance with Part 6.

#### §130.0(c)9

Light emitting diode (LED) Luminaires and LED Light Engine.

- A. The wattage of such luminaires shall be the maximum rated input wattage of the system when tested in accordance with IES LM-79-08.
- B. The maximum rated input wattage shall be labeled in accordance with §130.0(c)1. See section 6.4.1 of this chapter for additional information on luminaire labeling requirements.
- C. An LED lamp, integrated or non-integrated type in accordance with the definition in ANSI/IES RP-16-2010, shall not be classified as a LED lighting system for compliance with Part 6. LED modules having screw-bases including screw based pig-tails, screw-based sockets, or screw-based adaptors shall not be recognized as a LED lighting system for compliance with Part 6.
- D. Luminaires and luminaire housings equipped with screw-base sockets shall not be classified as a LED lighting system for compliance with Part 6.
- E. Luminaires manufactured or rated for use with low-voltage incandescent lamps, into which have been installed LED modules or LED lamps, shall not be recognized as a LED lighting system for compliance with Part 6.
- F. For LED lighting systems which allow the addition of luminaires or light engines without rewiring, the wattage of such luminaires shall be the maximum rated input wattage of the power supply, labeled in accordance with §130.0(c)1 or published in the power supply manufacturer's catalog.

## Table 150.0 - A

Table 150.0-A is shown as Table 6-1 in this chapter. According to Table 150.0-A, some of the lighting systems classified as residential high efficacy include the following:

1. GU-24 sockets rated for LED lamps.
2. Luminaires using LED light sources which have been certified to the Commission as high efficacy in accordance with Reference Joint Appendix JA8.
3. Luminaire housings rated by the manufacturer for use with only LED light engines.

Also, according to Table 150.0-A, lighting systems classified as residential low efficacy include:

1. Line-voltage lamp holders (sockets) capable of operating incandescent lamps of any type.
2. Low-voltage lamp holders capable of operating incandescent lamps of any type.
3. High efficacy lamps installed in low-efficacy luminaires, including screw base compact fluorescent and screw base LED lamps.
4. Track lighting or other flexible lighting system which allows the addition or relocation of luminaires without altering the wiring of the system.
5. Luminaires using LED light sources which have not been certified by the manufacturer to the Commission as high efficacy.
6. Lighting systems which have modular components that allow conversion between high-efficacy and low-efficacy lighting without changing the luminaires' housing or wiring.

#### 6.9.4 Qualification Requirements for Residential Luminaires Using LED Light Source

Following is the language from Reference Joint Appendix JA8, which is required by manufacturers to qualify LEDs as residential high efficacy.

##### Reference Joint Appendix JA8

To qualify as a residential high efficacy luminaire using Light Emitting Diode (LED) as the light source (as defined in IES LM-80-2008), the LED light engine (as defined in ANSI/IES RP-16-2010) used in the luminaire shall be certified to the Energy Commission according to all of the following requirements, or by a method approved by the Executive Director.

If the LED light engine is inseparable from the luminaire (integral LED luminaire) then the entire luminaire shall meet the same requirements. LED light engine(s) and integral LED luminaire(s) are referred to as LED luminaire(s) below.

- a. Shall be manufactured for use in residential applications.

LED luminaires not intended for use in residential applications, LED landscape luminaires, and luminaire housings not containing a light engine shall not be

certified to the Energy Commission for the purpose of complying with Joint Appendix JA-8

- b. The efficacy of the integral LED luminaire or LED light engine, when tested in accordance with IES LM-79-2008, shall be equal to or greater than the efficacies contained in Table 6-6 (Table JA-8 in the Standards).
- c. When designed or rated for indoor use shall be capable of providing a nominal Correlated Color Temperature (CCT) that includes at least one point within the range of 2700K to 4000K;

When designed or rated for outdoor use shall be capable of providing a nominal CCT that includes at least one point within the range of 2700K to 5000K. (With tolerance defined as in ANSI C78-377-2008)

Exception to subsection (c): Monochromatic LEDs that are only for decorative purposes

- d. Shall be capable of providing a minimum Color Rendering Index (CRI) of 90.

Exception 1 to section (d): Monochromatic LEDs that are only for decorative purposes.

Exception 2 to section (d): LED luminaires used for compliance with the outdoor lighting requirements in Title 24, Part 6, Section 150.0(k)9.

If the color of the LED cannot be varied by the user or by an automatic system, then the color rendering index (CRI) shall be at least 90. If the color of the LED can be varied by the user or by an automatic system, then at least one of the color variations shall have a CRI of at least 90.

- e. An LED light engine shall be capable of being installed in luminaire housing without using any type of base or socket used for incandescent lamps; it may include a GU-24 or modular quick connect, but shall not include screw base sockets or adaptors of type and size E12 through E39.
- f. An LED lamp, integrated or non-integrated type in accordance with the definition in ANSI/IES RP-16-2010, shall not be certified to the Energy Commission as a high efficacy luminaire or high efficacy light engine, and shall not be classified as a high efficacy luminaire for compliance with Title 24, Part 6 of the CCR.
- g. The integral LED luminaire or LED light engine under test shall be tested in a Underwriters Laboratory (UL) 1598 testing apparatus in a testing laboratory participating in the ISO/IEC 17025, by the National Voluntary Laboratory Accreditation Program (NVLAP) or other laboratory accreditation body operating in accordance with ISO/IEC 17011 and produced under an ongoing inspection program carried out by a Type A inspection body in accordance with ISO/IEC 17020, accredited to ISO/IEC 17020 by an accreditation body operating in accordance with ISO/IEC 17011.
- h. Each integral LED luminaire or LED light engine tested shall produce the same quantity and quality of light. An integral LED luminaire or LED light engine under test producing different Correlated Color Temperature (CCT), Color Rendering Index (CRI), total flux (per linear foot for linear systems) or other quantitative and qualitative differences in light shall be separately tested and separately certified to the Energy Commission.
- i. A worst case test may be used to certify a group of integral LED luminaires or LED light engines having the same quantity and quality of light in accordance with section (h).

- j. For determining efficacy, the input wattage of the integral LED luminaire or LED light engine under test shall be determined as follows:
1. For single LED luminaires, use the maximum rated input wattage of the luminaire.
  2. When multiple LED light engines are connected to a single power supply, all possible combinations shall be tested to determine the various input wattages and efficacies for the power supply under test. The combination providing the worst case efficacy shall be the system efficacy.
  3. LED luminaires, installed on lighting track that is capable of being used with multiple lighting technologies, shall be treated as single LED luminaires in accordance with section (j)1.  
Lighting track capable of accommodating any non-LED lighting technologies shall not be certified as LED lighting.
- k. For single LED luminaires, maximum rated input wattage, total luminous flux, CCT, and CRI of the integral LED luminaire or LED light engine under test shall be listed on a permanent, pre-printed, factory-installed label on the circuit board, light engine, or luminaire housing.
- l. For LED systems in accordance with section (j)2, all possible wattage combinations, luminous flux, CCT, CRI, and efficacies of each of possible combination of the integral LED luminaire or LED light engine under test shall be listed on a permanent, pre-printed, factory-installed label on the power supply, or published in manufacturer's catalogs.

*Table 6-6 – (Table JA8 in Nonresidential Appendix JA-8) High Efficacy Qualification Requirements for Luminaires or Light Engines Using LED Light Sources. (This table is the same as Table 6-2 of this chapter)*

<b>Power Rating per Integral LED Luminaire, or per LED Light Engine Under Test</b>	<b>Minimum Efficacy (Lumens Per Watt)</b>
5 watts or less	30
Over 5 watts to 15 watts	45
Over 15 watts to 40 watts	60
Over 40 watts	90

## 6.10 Residential Lighting Compliance Documentation

This section covers residential lighting compliance documentation (compliance forms) that is required to be submitted to the Authority Having Jurisdiction (AHJ) for compliance with the residential lighting Standards.

Because the compliance documentation for residential lighting consists primarily of a Certificate of Installation, it is not to be submitted until after the lighting project has been completed.

As stated in section 6.1 of this chapter, all of the residential lighting requirements are mandatory measures. There are no tradeoffs between lighting and other building features.

## 6.10.1 Certificate of Installation

### A. Person Responsible to Submit the Certificate of Installation

The Certificate of Installation is required to be submitted by a person eligible under Division 3 of the Business and Professions Code to accept responsibility for construction for all residential lighting projects. In this Certificate of Installation, the person accepting responsibility for the project declares that the installed residential lighting complied with all of the applicable lighting requirements.

### B. Number of Certificates of Installation Required

A residential lighting project may require only one, or more than one, Certificate of Installation to be submitted. For example, if one qualified person accepts responsibility for the lighting installation of an entire lighting project, only one Certificate of Installation will need to be submitted. However, if one qualified person accepts responsibility for the installation of the lighting controls, and another qualified person accepts responsibility for the installation of the luminaires, then each qualified person will separately need to submit a Certificate of Installation.

A Certificate of Installation must be submitted to the AHJ for any residential lighting project that is regulated by Part 6, whether that lighting project is for only one luminaire, or for the lighting of an entire building.

### C. CF-2R-LTG

The Energy Compliance documentation has been revised and reorganized. The Certificate of Installation for residential lighting is now CF-2R-LTG.

### D. Registration

New requirements for a documentation procedure called registration were introduced beginning with the 2008 Building Energy Efficiency Standards.

Registration is now required for all low-rise residential buildings for which compliance requires HERS field verification. When registration is required, persons responsible for completing and submitting compliance documents, including the CF-2R-LTG, are required to submit the compliance form(s) electronically to an approved HERS provider data registry for registration and retention.

Registration requirements are detailed in Chapter 1 of the 2013 Residential Compliance Manual.

The Certificate of Installation for residential lighting is completed and signed by the contractor responsible for installing hard-wired lighting systems. The installer verifies compliance with the mandatory requirements for lighting, and whether high efficacy lighting of the alternate controls (occupancy sensors, dimmer switches, etc.) was installed. Kitchen lighting and cabinet lighting wattages are indicated on this form when applicable.

When any HERS verification is required for compliance all of the CF-2R forms must be registered documents from an approved HERS provider data registry.

The builder or installing contractor responsible for the installation must provide a copy of the completed, signed, and registered Certificate(s) of Installation to the HERS rater, and post a copy at the building site for review by the enforcement agency in

conjunction with requests for final inspection, and provide copies of the registered CF-2R forms to the home owner,

## 6.10.2 Documentation for Lighting Control Systems

### A. Person Responsible to Submit the Certificate of Installation

As explained in section 6.2.2 of this chapter, lighting control systems are required to comply with the Certificate of Installation requirements in §130.4.

Even through the Certificate of Installation for lighting control systems is designed primarily for use as a nonresidential compliance document, it is also required whenever a lighting control system is used to comply with the residential lighting Standards.

This Certificate of Installation is also required to be submitted by a person eligible under Division 3 of the Business and Professions Code to accept responsibility for construction for all residential lighting projects. In this Certificate of Installation, the person accepting responsibility for the installation of the lighting control system declares that the installation complied with all of the applicable lighting requirements.

### B. Certificate of Installation Requirements in the Standards

Following is language in the Standards that requires the Certificate of Installation to be submitted when a lighting control system is installed to comply with any of the residential lighting control requirements.

#### §150(k)2F

Lighting controls shall comply with the applicable requirements of §110.9.

#### §150(k)2G

An Energy Management Control System (EMCS) may be used to comply with dimmer requirements in §150.0(k) if at a minimum it provides the functionality of a dimmer in accordance with §110.9, meets the installation certificate requirements in §130.4, the EMCS requirements in §130.5, and complies with all other applicable requirements in §150.0(k)2.

#### §150(k)2H

An Energy Management Control System (EMCS) may be used to comply with vacancy sensor requirements in §150.0(k) if at a minimum it provides the functionality of a vacancy sensor in accordance with §110.9, meets the installation certificate requirements in §130.4, the EMCS requirements in §130.5, and complies with all other applicable requirements in §150.0(k)2.

#### §150(k)2I

A multi-scene programmable controller may be used to comply with dimmer requirements in §150.0(k) if at a minimum it provides the functionality of a dimmer in accordance with §110.9, and complies with all other applicable requirements in §150.0(k)2.

#### §110.9(a)4.

Lighting Control Systems, as defined in §100.1, shall be a fully functional lighting control system complying with the applicable requirements in §110.9(b), and shall meet the Lighting Control Installation requirements in §130.4.

#### §130.4(b) Lighting Control Installation Certificate Requirements

To be recognized for compliance with Part 6 an Installation Certificate shall be submitted in accordance with §10-103(a) for any lighting control system, Energy Management Control System, track lighting integral current limiter, track lighting supplementary over current protection panel, interlocked lighting system, lighting Power Adjustment Factor, or additional wattage available for a videoconference studio, in accordance with the following requirements, as applicable:

1. Certification that when a lighting control system is installed to comply with lighting control requirements in Part 6 it complies with the applicable requirements of §110.9; and complies with Reference Nonresidential Appendix NA7.7.1.
2. Certification that when an Energy Management Control System is installed to function as a lighting control required by Part 6 it functionally meets all applicable requirements for each application for which it is installed, in accordance with Sections 110.9, 130.0 through 130.5, 140.6 through 150.0, and 150.2; and complies with Reference Nonresidential Appendix NA7.7.2.